Summer 1965

South Dakota Farm and Home Research

Agricultural Experiment Station

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South Dakota

FARM & HOME RESEARCH

Plants Without Seeds — See Page 27.

Agricultural Experiment Station
SOUTH DAKOTA STATE UNIVERSITY
Brookings, South Dakota

contents . . .

• SOUTH DAKOTA STATE UNIVERSITY--"SERVING THE PEOPLE OF SOUTH DAKOTA THROUGH TEACHING, RESEARCH, EXTENSION." •

SOUTH DAKOTA FARM AND HOME RESEARCH

Volume XVI — Summer, 1965 — Number 3

A Report of Progress

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From the Dean and Director

Honors, citations, and recognition earned by faculty and former students down through the years all represent a heritage for South Dakota State University. Each year faculty, students and former students add to this heritage.

Enumerated, such an honors listing would be lengthy and it would include accomplishments of incalculable value to State University, the State, the Nation, and the World.

Basically, such a list would represent people. True, the people would differ. But each would have these things in common: no fear of hard work, application of abilities, dedication, and vision for the future—a combination which brings success in many forms.

Such a person and an example of the diligent application necessary for success was James H. Shepard. He achieved international fame as a chemist, teacher, public servant, author, and as a man highly respected in his community. He did this while serving some 30 years at a small obscure college in a pioneer state. He dealt with live, critical problems which this area faced 75 years ago. And much of the knowledge this man of science gained then still finds application and use in research and teaching.

Professor Shepard came to State in 1888 as a chemistry teacher and began a South Dakota career of solid accomplishment until his death in 1918. He served several years at the turn of the century as Director of the Agricultural Experiment Station.

While his accomplishments were varied, Professor Shepard was a recognized authority in most of them. He pioneered studies on improving South Dakota drinking water in 1888. As early as 1889 he began experiments with sugar beets. Possibilities of irrigation in the James River Valley and elsewhere in the state occupied his attention beginning in the 1890's.

Professor Shepard's investigations resulted in barring preservatives and coal tar dyes from foods. His testimony for American, English, and South American governments concerning blanched flour also contributed to barring bleached flour from interstate and international trade. His work on a commission appointed by President Taft to analyze whiskey led to a standard by which all liquors could be judged.

His several textbooks on chemistry sold in the tens of thousands. One of them on inorganic chemistry written in the 1880's remained in print for almost half a century.

A former student once said Professor Shepard "raised the curtain a bit for me and gave all his students a peek at the great field of chemistry . . . anyone who couldn't understand chemistry when Jimmy Shepard taught it had no business expecting to finish college."

Naming South Dakota State University's new classroom-laboratory building in honor of James H. Shepard at dedication ceremonies last spring was a fitting tribute to a man whose outstanding characteristics were his sensitivity to the needs of people and the responsibility as a scientist he felt to society. Shepard Hall has been characterized as a new "tool" to teach chemistry and to conduct chemical research. The new four-story, completely modern facility, through the Department of Chemistry, will be used to the maximum in the pursuit of excellence and achievement, the two earmarks which have always characterized the purpose of South Dakota State University.

In Shepard Hall, South Dakotans, through the Regents of Education, have established a fitting memorial to a distinguished scientist who brought many honors to South Dakota. — Orville G. Bentley.

Shepard Hall.

What's BENEATH the Hide?

By Harold J. Tuma, *assistant professor of animal science*

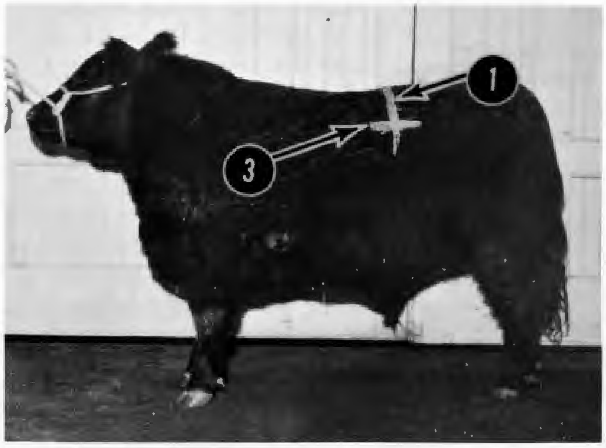


Figure 1. The same beef animal, live and two days later as carcass. 1—outline of the muscle area which is the rib-eye in the carcass, also the point where this would be on the live animal. 2—cut surface of the muscle used to determine many quality or "eatability" traits. 3—point where outside fat thickness is measured on the carcass, and the approximate location on the live animal.

What's beneath the hide?

How much fat or muscle will that animal produce?

What kind of a carcass will this animal hang up?

These are questions frequently asked wherever people talk about livestock—at fairs, shows, in the classroom, and in the stockyards. Actually, these questions reflect what has long been sought in the livestock industry: how to get a better dinner plate estimate of an animal's value by viewing what's "on the hoof."

In no other industry is so little actually known about the product traded or evaluated. Animals, in the past and to some extent yet today, have been bought, sold, placed and evaluated largely on their external appearance.

Today, competition, the need for efficiency, and an increasing demand for more lean and less fat have spurred us into using new tools and techniques plus training the eye to look for indications which reveal more about the composition of an animal.

USING ULTRASONICS

Ultrasonics (high frequency sound) probes and linear measurements have been used in an attempt to measure carcass muscling or the cut-out potential of an animal. The amount of quantity of lean, muscling and retail cut-out yield are all indicators of basically the same thing: how many pounds of salable cuts a given animal will produce. These objective measures of carcass merit have not yet proved to be as accurate as desired and in most cases have little, if any, advantage over the "experienced human eye." Research continues on improvement of these methods of measurement. However, even if improved, it would often be impossible or impractical to use these instruments or techniques. The "eyeball" estimate is still important.

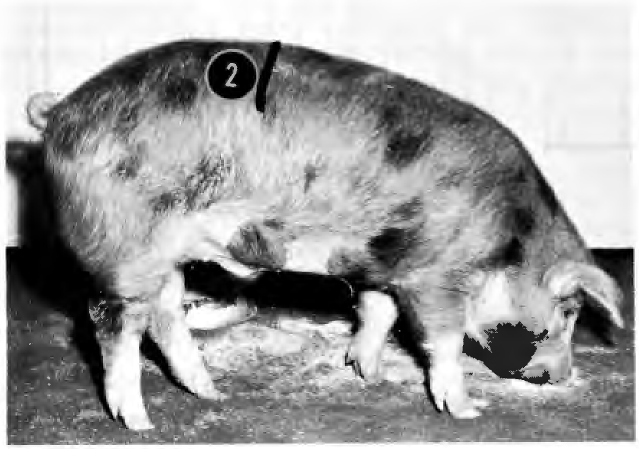
Thus is emphasized the great need to gain experience in actually evaluating the live animal in an attempt to predict its carcass merit. Some of our time-honored show ring concepts have not been good indicators of carcass merit. In years past there has not always been close cooperation between the meats or carcass judge and the live animal judge. However, each needs to realize the other's problems and accept the fact that any one segment of the industry is not set apart from any other.

Courses in the Animal Science Department at South Dakota State University stress meat animal evaluation. They are taught jointly by livestock and meats judging personnel. Other universities also have courses of this type.

MEAT ANIMAL EVALUATION

Interest in meat animal evaluation was stimulated a number of years ago when the National Live Stock and Meat Board, with assistance of stockyard companies and packing plants, sponsored meat animal evaluation clinics at various points around the country for college students. In the Midwest these clinics led to an annual Intercollegiate Meat Animal Evaluation Contest. The second contest was held at Waterloo, Iowa, in April of this year. These activities on a regional or national basis have fostered increased interest at the state level.

In February of this year a Meat Animal Evaluation Clinic was held on the SDSU campus for county extension agents and 4-H club leaders. Objectives were to promote knowledge of live animal factors important in the carcass and to demonstrate the increasing need



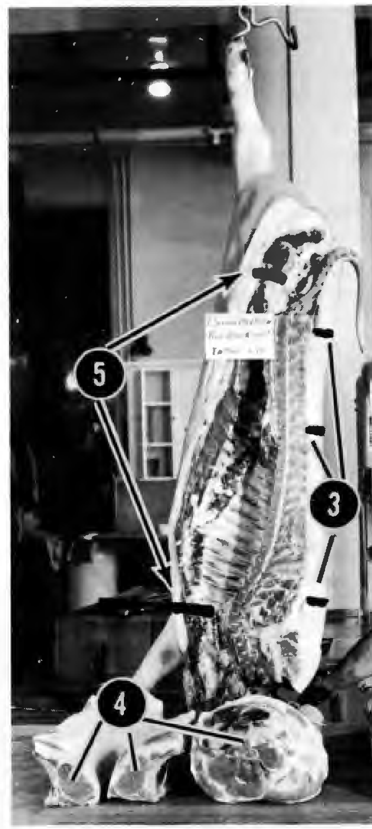
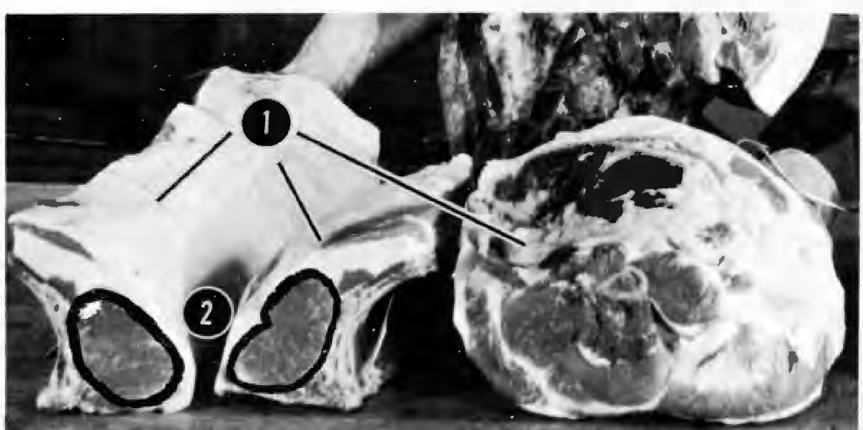


Figure 2. The same hog, alive and as carcass. 1—trimmed ham and loin. Weight of these cuts figured as a percentage of the side weight is an indicator of muscling. 2—outlined area on either portion of the loin and the line on the live animal show muscle area measured to obtain the loin-eye area. 3—backfat thickness is measured at these three points and the average used as an indicator of finish. 4—quality, as evaluated in contests, may be determined on both the loin-eye surface and ham face. 5—length is determined between the anterior edge of the aitch bone (top arrow in photo of carcass) and the anterior edge of the first rib (bottom arrow).



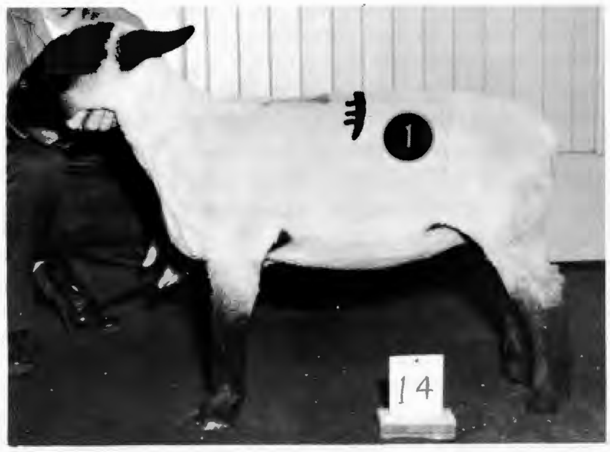
for close cooperation among all segments of the industry so that meat animals may be produced, marketed and utilized more efficiently. Clinics and contests of this type usually prove to be an eye-opener for a person not familiar with evaluation procedures. For example, in market classes the fattest animal usually is not the one that is considered correctly finished. Consumer aversion to fat has led to this selection change.

Photos in figures 1, 2 and 3 illustrate how comparisons were made between live animal evaluation estimates and actual carcass measurements. County agents and others who took part in the clinic learned that with some experience the economically important carcass traits can be evaluated in the live animal with relative accuracy.

What indicators are we trying to evaluate or peer through the hide to see? The **QUALITY** and **QUANTITY** of lean or muscle in the beef, pork or lamb carcass is very closely related to economic value. Quality refers to the visual characteristics of the muscle (marbling, color, etc.) in the carcass which predict the eatability. Quantity of lean is synonymous with the amount of retailable or salable meat. Indicators of these items are what we need to attempt to estimate in the live animal.

More specifically, the traits we are trying to evaluate in beef, pork and lamb and what they indicate are:

Figure 3. The same lamb before and after slaughtering. 1—fat thickness is measured and an average taken at the three points over the eye. 2—rib-eye area is measured on the outlined muscle between the 12th and 13th ribs. None of the auxiliary muscles adjacent to the eye muscle are included. Lamb carcasses, under normal commercial conditions, are not ribbed for grading, hence the grade is a composite of conformation and the internal indications of quality.



BEEF

- Estimated carcass gradé—indicates quality (eating quality).
- Rib-eye area (square inches estimated at the 12th rib)—a large rib-eye indicates meatiness.
- Fat thickness (inches estimated at the 12th rib)—more fat at this point indicates an excessive fat trim may be necessary to have a desirable retail cut.
- Dressing percent — indicates the proportion of the animal that will be in the dressed carcass. Dressing percent itself is of little value in approximating carcass merit, but is used by the trade at the present time.

Accurate predictions of the amount of retailable or salable meat can now be made using carcass-measured rib-eye area, fat thickness, kidney fat and carcass weight. Much progress is being made to accurately extend this prediction to the live beef animal.

Most of these quality and quantity traits are highly heritable. This means we can specifically select for these traits and thereby improve our meat animals. However, the advancement to be made in these areas, at best, will be slow.

PORK

- Backfat (inches)—more fat, in animals of the same weight, leaves a smaller proportion of the carcass in lean.
- Loin eye (square inches)—is an indicator of total muscling, the larger the better.
- Percent hame and loin—a large portion of the total value is located on these two choice cuts.
- Length—29 inches or longer is more desirable.

Pork quality, mentioned above, is becoming more important as problems related to the eating quality crop up. All of these estimable traits indicate quantity rather than quality of muscle. Quality in the live animal is difficult to evaluate. Soft, watery pork is objectionable, while dark, firm muscle is desired.

LAMB

Lambs are most accurately evaluated on a shorn basis. Traits to be considered are:

- Fat thickness—0.2 to 0.3 of an inch is most desirable. Some fat is needed on lamb or any animal so that carcass or cuts may be transported, if necessary, and then processed into attractive retail cuts. Excess fat, however, is waste and should be avoided.
- Loin-eye area—the larger the more desirable.
- Carcass grade—used as an indicator of eating quality; choice is desirable.
- Dressing percent—the same as with other animals, not very closely related to carcass merit.

LOOK TO FUTURE

Persons associated with animal science teaching, research and Extension have the responsibility of helping to guide livestock producers toward the type of animal they must produce 10, 20 or even 30 years from now to remain competitive. Animal science researchers and teachers feel that meat animal clinics and contests which train the "eye" to properly evaluate sought-after traits will help all associated with the livestock and meat industry to more adequately select breeding or market animals.

There is no "magic" in knowing just what we must produce. The meat animal must be lean and meaty with a minimum of outside and intermuscular fat, and yet be of acceptable quality. This is not an impossible combination, yet is a far cry from some of the fat, wasty, heavy animals we are producing today.

The animal "beauty contests," as such, must be altered so they are related to the kind and amount of product being produced. This does not mean the animals need to lose their aesthetic value. However, efficiency of production as well as product quantity and quality should be of primary concern. □

SILAGE PRESERVATION

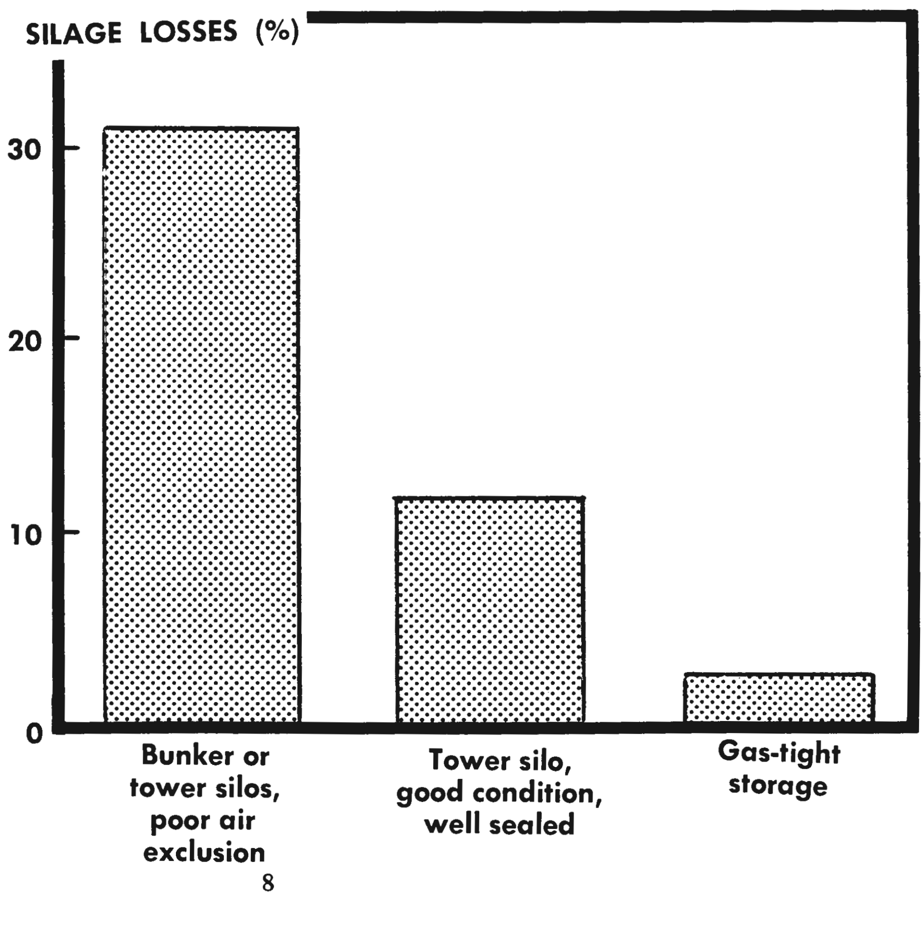
Its Effects on
⁘Composition
⁘Losses

Silages are a major livestock feed in South Dakota.

And, the trend is toward even more silage feeding.

In 1963 more than 4 million tons were fed in South Dakota. From 1950 through 1961 less than half this amount was fed each year. A storage loss in feeding value of silage of 25%—and this estimate is considered representative — figures up to around a million tons of feed

By Howard H. Voelker,
professor, and
Emery Bartle,
associate professor, dairy science.



annually for South Dakota. At $7.00 a ton, this is a substantial sum on the minus side of the profit-loss ledger.

Some methods of ensiling feed crops may not exclude enough air which results in spoilage and loss in feeding value. Farmers, scientists and industry for years have been trying improved ensilage methods to eliminate at least some of these losses.

Determination of costs of various silage storage methods was not a part of this particular Experiment Station research project. Gas-tight storage, for instance, showed minimum losses. But gas-tight storage facilities may not be available so other methods of preservation often must be used. In this experiment gas-tight storage established a "base" or "minimum-loss" guide from which comparisons of other storage types were made.

Alfalfa and Oats Used in Studies

Research procedures included weighing in and weighing out silage from bunkers, upright, and gas-tight structures. Forages used were alfalfa and oats. These forages, especially alfalfa, are more difficult to preserve than corn or sorghums, which are higher in fermentable carbohydrates that yield preserving acids more abundantly. Alfalfa was weighed in and out of bunkers and compared with similar material in gas-tight storage (table 1).

Table 1. Alfalfa losses in bunkers and gas-tight storage.*

Silo	Moisture	Carotene as fed	Total weight losses
	(%)	(mcg. per g.)	(%)
Bunker	66.6	38	32.4
Gas-tight	48.9	72	3.4

*Three trials were conducted with bunkers and three with gas-tight storage.

Figure 1. Comparative silage preservation losses in different conditions of storage.

Alfalfa was preserved at an average of 66.6% moisture in the bunkers. In gas-tight storage moisture content averaged 48.9% as a consequence of longer wilting time in the field. About twice as much carotene was preserved in the gas-tight storage as in bunkers. Because carotene is destroyed by light and air, it means that less exposure to light and air are factors in the higher retention of carotene in gas-tight storage than in bunkers. The weigh ins and weigh outs of silages showed considerable difference in total weight loss with gas-tight storage having less than bunker storage.

Samples of the alfalfa were taken for chemical analyses as the forages were put into the structures and again as the preserved alfalfa was fed. Averages of alfalfa composition are summarized in table 2.

Table 2. Changes in composition of alfalfa during preservation.

Silo	Ether extract	Crude fiber	Crude protein	Ash	Nitrogen-free extract
	Dry matter percent				
Bunker					
as ensiled	3.0	23.3	21.1	8.9	43.7
as fed	2.9	26.0	21.2	12.0	37.9
change	—.1	+2.7	+.1	+3.1	—5.8
Gas tight					
as ensiled	2.9	22.0	22.6	9.7	42.2
as fed ...	3.2	25.3	21.2	9.0	41.3
change	—.3	+3.3	—1.4	—.7	—.9

It is apparent that the greatest differences between the types of storage occured in the ash and nitrogen-free extract portions. The mineral matter, or ash, was relatively stable. As the decomposable carbohydrates were used as a source of energy in silage fermentation, the relative proportion of the ash increased. In gas-tight storage there was considerably less loss of carbohydrates than in the bunkers.

Weights In and Out of Storage

The typical weights in and out of storage indicated (table 1) a total weight loss in the bunkers of 32.4% as compared to 3.4% in gas-tight storage.

A further trial on weight loss of silage used a concrete tower silo in which the doors were lined with plastic as the silo was filled. A plastic cover, placed over the alfalfa immediately after filling, was weighted at the edges with green alfalfa. The weight in totaled 71,460 pounds and the weight out 63,183 pounds for a loss of 8,277 pounds or 11.6%. This loss occurred over a storage time of about 3 months.

Using a similar alfalfa, 63,123 pounds were weighed into gas-tight storage and 60,598 pounds weighed out — a loss of 2,525 pounds or 4.0%. If concrete silos are not relatively air-tight and properly sealed, however, it is conceivable that losses might be considerably higher. Larger amounts of silage in tower silos would probably result in lower percentage losses than were present under the experimental conditions. Losses may be reduced if the silos are relatively new and tight in sidewalls and doors, and if they are sealed on top immediately after filling.

Oat Silage Preservation

Oat forage is likely to result in relatively high preservation losses for several reasons. The oat stem is hollow and unless properly packed, it is likely to retain some air. Also, the carbohydrate material may not be fermented as readily as in sorghums or corn.

To study oat silage preservation losses, two bunkers and two upright concrete stave silos were used. The procedure was similar to that used for alfalfa. Silages were weighed in as silos were filled and weighed out at feeding time 4½ months later. The oats were in the late milk to early dough stages of maturity and were chopped to ½- to 1-inch lengths.

The edible and non-edible portions off the top of the silos were determined arbitrarily. Some feed bunk refusal was included in non-edible spoilage. One of the upright silos was left without sealing. It was old and the doors were not tight. On the other tower silo, doors were lined on the inside with plastic. A plastic cover was placed on top and weighted down immediately after filling.

One bunker was not packed except for trucks driving over the silage during unloading plus some incidental packing with a bulldozer. This silage was stirred with the bulldozer blade during and one day after filling to get the silage as deep in the bunker as possible. Silage was pushed from the ends to the top and middle of the bunker. It was realized later that the incorporation of air through stirring in this manner may have been detrimental to the silage preservation. The stirring was not done intentionally to add air, but to get as great a depth of silage in the bunker as possible. The other bunker was moderately packed with a conventional 4-wheel heavy tractor.

Table 3 shows the moisture contents and various losses of the oat silages.

The old silo with doors in poor condition and which was not covered with plastic had high carotene and total silage losses. Also, the bunker in which the silage was stirred and air reincorporated, had high losses of carotene and total silage. Sealing doors with plastic and immediate sealing of the top with plastic after filling appeared to be very beneficial in reducing spoilage to 14.6% in the upright. Also, this treatment resulted in improved carotene preservation.

Table 3. Oat silage losses

Silo	Condition of silo and treatment	Silage moisture	Carotene as fed	Total weight loss
		(%)	(mcg. per g.)	(%)
Upright	old, poor doors, not sealed	72.2	30	29.6
Bunker	silage stirred	67.5	33	37.1
Upright	doors and top sealed	69.1	117	14.6
Bunker	silage packed	64.0	23	30.9

Packing silage in the bunkers appeared to result in somewhat lower losses than where the silage was stirred. The problem with bunkers (or piles of silage on the ground) is that a relatively high proportion of the silage is exposed to air. This exposure to air during fermentation causes relatively high silage losses.

Table 4 shows that high losses resulted from conditions which permitted air to enter the silage. These included silo doors in bad condition, not sealing the top of the silo with plastic, stirring the silage as it fermented, and exposure to air on the top and ends of bunkers. Where air hit the silage, the percentage of crude fiber tended to increase. This may have happened because the other carbohydrates, represented by nitrogen-free extract, tended to be lost in the spoilage process. The ash, or mineral values, also tend to increase to a greater extent where total losses were high. The readily decomposable carbohydrates were used up in the presence of air. This phenomenon can account for a large part of the differences which have been shown in feeding trials in which average daily gains of livestock tend to be relatively high when feeds preserved in gas-tight storage are fed. Other factors such as palatability of the feeds also probably enter into gains—livestock eat more of the better-preserved feeds.

Table 4. Changes in oat silages during preservation.

Silo and description	Dry matter composition: Ether extract	Crude fiber	Crude protein	Ash	Nitrogen-free extract
			(%)		
Upright, ensiled	3.8	28.2	12.1	9.5	46.4
not sealed, fed	3.7	31.3	11.1	14.7	39.2
change	—.1	+3.1	—1.0	+5.2	—7.2
Bunker, ensiled	3.8	28.9	12.9	8.6	45.8
stirred, fed	3.4	30.0	12.0	16.2	38.4
change	—.4	+1.1	—.9	+7.6	—7.4
Upright, ensiled	3.6	30.1	11.6	10.2	44.5
Sealed, fed	3.9	30.7	9.8	10.8	44.8
change	+.3	+.6	—1.8	+.6	+.3
Bunker, ensiled	4.1	26.7	10.7	8.8	49.7
Packed, fed	3.0	29.6	12.5	11.0	43.9
change	—1.1	+2.9	+1.8	+2.2	—5.8

Chemical Composition of Spoiled Silages

Samples from rotten or decomposed silage on the bunker tops and unsealed silos showed an average increase of 4.4% in crude fiber during the process of storing. Protein, based on nitrogen analyses, decreased 0.7%. It is probable that some of the protein decomposed into non-protein nitrogen, as previous research has shown. The nitrogen-free extract, or readily decomposable carbohydrates such as starch and sugars, decomposed 10.8%, and in one silo it decomposed 21.2%. Most of the original carotene was lost in the spoilage process. The decomposed silage had 0 to 3 or 4 micrograms per gram of carotene of silage.

Figure 1 summarizes silage losses which were found under the various experimental conditions. It shows that exclusion of air in fermentation and storage of silage is extremely important in reducing silage preservation and storage losses.

LEPTOSPIROSIS

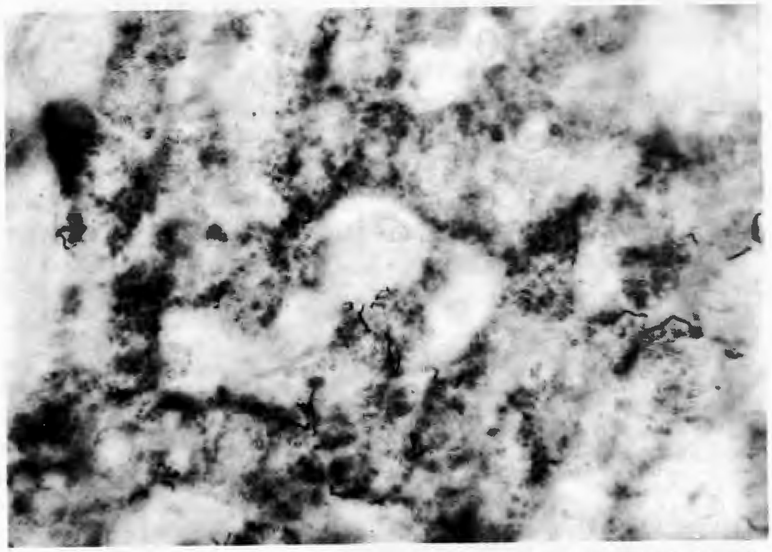


Figure 1. Leptospira (tiny, dark thread-like objects) stained with silver in tissues of inoculated guinea pig. (Magnified about 1,000 times).

By John P. McAdaragh, *assistant professor;*
D. R. Wenger, *assistant professor;* and
G. S. Harshfield, *professor, veterinary science*

First association of leptospira with disease in cattle in the United States was made in 1944. Four years later the organisms were isolated from cattle and in 1952 from swine. It is now generally agreed that leptospirosis had occurred sporadically in the United States in cattle and swine prior to 1944 but had not been identified.

In South Dakota, leptospirosis was first diagnosed in 1950 in cattle in an outbreak involving about 2,000 heifers. Reported death loss was 75 head over a 4-month period. Additional diagnoses were made in other cattle herds and in swine. In 1955 the Department of Veterinary Science at South Dakota State University started a project to study leptospirosis in farm animals.

The history of leptospira infections dates back to 1886 when Weil described a form of infectious jaundice in humans in Germany. As similar human cases were recognized by others, the name Weil's disease was given to the human infection. The cause remained unknown until 1915-1916 when German and Japanese workers discovered leptospira organisms in blood and tissues of patients.

An early association of Weil's disease with small rodents, either directly or indirectly, was observed. Following the discovery of leptospira in human cases, infections with these organisms were also found in rats and mice with contamination of food, water and the environment by urine accounting for the human infections. Leptospira infections in dogs were found in 1917 and these also probably derived from the same sources.

Prior to 1935 leptospirosis had not been recognized in food producing animals. A Russian report of infection in cattle appeared that year. In 1939, leptospira were isolated from pigs in Australia. Since that time leptospirosis has been diagnosed in many countries and in many species of animals.

CAUSE

Leptospira are microorganisms classed as spirochetes which are long, thin and spiral in form. These organisms can be grown in laboratory media containing blood serum but growth is slow until becoming adapted to the artificial media. The dark field microscope is necessary to see the live organisms. They do not stain readily with dyes used with more common bacteria. It is possible by special staining techniques to demonstrate leptospira in

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Leptospirosis, so named because of the microorganism which causes it, is an economically important disease for livestock producers. Here are some facts about the disease as applied to South Dakota, briefed from this more detailed discussion by South Dakota State University veterinarians.

- First diagnosed in South Dakota during 1950 when 75 head of cattle were lost in a 4-month period during an outbreak involving 2,000 heifers.
- Heavier rates of infection are associated with wet conditions—1962 confirmed this observation in South Dakota.
- Signs of infection in animals may be fever, anemia, blood stained urine, decrease in amount and change in quality of milk from dairy cattle, abortions in cattle and swine.
- Spread by live leptospira organisms passed in urine which contaminate feed, water, bedding.
- Diagnosis is through blood tests and examination of tissues.
- Treatment is preventative rather than curative—that is, by immunization which is good against field exposure for about a year.
- Other suggestions: exterminate rodents, which are frequent carriers, from around farm buildings. Test animals from outside sources before adding to herds. Vaccinate under direction of a veterinarian.
- Use caution—humans can be infected with the leptospira that infect animals.

infected kidney tissues (figure 1).

Approximately 60 serotypes of leptospira are reported. These are identified on the basis of antigenic differences. Some of them are known to be world-wide in distribution, others are either limited to smaller areas, or information is lacking. In United States, the predominant serotype causing infections in cattle and swine is *Leptospira pomona*. A few others have been identified in these species but wide distribution has not been demonstrated.

Experience with leptospirosis throughout the world emphasizes that a number of factors influence the establishment of infection. Climate, soil characteristics and animal populations that can serve as reservoirs of infection have to be considered. In the history of leptospirosis it has been noted that heavier rates of infection have been associated with wet conditions. Leptospira do not survive long in the environment under dry conditions or in highly alkaline or acid soils.

ANIMALS SUSCEPTIBLE

Leptospira have been isolated from many species of animals, both wild and domestic, and from man. It is doubtful if any species of warm-blooded mammal is completely resistant to infection. Many of the numerous serotypes of leptospira have been recovered from various species of rodents. Isolations have been made from both carniverous and herbiverous wild animals. Several leptospiral serotypes have caused infections in dogs, cats, cattle, swine, horses, sheep and goats.

There is also variation in the disease-producing ability of the various serotypes in animal species. As an example, *L. pomona* causes a fatal disease in chinchillas, a general reaction with fever and icterus but seldom death in guinea pigs while in rabbits there is little or no reaction.

Among the food producing animals, sheep apparently have much more natural resistance than cattle and swine to *L. pomona* infection.

SIGNS OF INFECTION

Infection occurs by leptospira organisms being taken into the body. They may enter the body by the mouth or nasal passages, through the conjunctiva of the eyes or through abrasions of the skin. Within a few days organisms are present in the circulating blood. In this manner they reach all tissues early in the course of the infection.

The signs of leptospira infection in cattle are varied. In some, an acute disease is produced with fever, anemia, icterus and hemoglobinuria (blood stained urine). Deaths may occur as a result of the anemia, especially in young animals. In milk cows, a marked decrease in quantity and change in quality of milk is seen together with some or all of the other signs. In one or more milkings, a pink color may be noted in the milk, or it will be thick and yellow. In a cow herd, abortions may result from leptospirosis. Many animals in infected herds are less severely affected, and in some, signs are so mild that they are not detected.

In swine, abortions are the only outward signs of leptospirosis. The abortions occur in late pregnancy, generally in the last three weeks. Some of the litters may be full-term or near-term but contain dead or weak pigs. The rate of abortion in infected herds has been as high as 80% of the sows. With few exceptions, the sows survive. As with cattle, infections also occur in swine without signs being detected.

TRANSMISSION

Regardless of the species of animal or the serotype of leptospira involved, leptospira organisms tend to localize in the kidneys. They cause a mild inflammation in these organs and persist and multiply in this location for several weeks or months. During this time live organisms are shed in urine. This provides the important means of spread of infection by the contamination of feed, water or bedding. The length of time after infection occurs that infected animals will shed leptospira is variable and there is at present no practical means of determining when such animals can be considered safe.

DIAGNOSIS

About a week to 10 days after exposure occurs, specific antibodies for leptospirosis appear in the blood. The level of antibodies rises during the course of infection. The detection of these antibodies provides the most practical procedure in the diagnosis of leptospirosis.

The test employed is an agglutination test. Blood serum from the animal is mixed with a suspension of leptospira organisms (antigen). If specific antibodies caused by infection are present in the serum, clumping of the organisms occurs. In applying the test in this laboratory, a preliminary or rapid test is made employing a concentrated antigen. On serum samples giving a reaction to this test, a second test is applied using dilutions of serum to determine the degree of reaction or titer. For this a live culture of leptospira is used as antigen.

A positive test for leptospirosis has some limitations in the interpretation:

(1) A positive test does not necessarily indicate an active or recent infection. Many animals which have recovered and are no longer shedding leptospira in the urine still carry antibodies in low titer that are detected by the test.

(2) Leptospirosis vaccination results in positive reactions. We have observed that vaccination reactions generally do not reach as high titers as are produced by actual infection.

(3) Low titer reactions may mean —

(a) a recent infection in which titers have not yet reached a peak;

(b) a long standing infection in which the titer has receded;

(c) a reaction from vaccination.

Past history of the herd and signs of disease should be considered for the most accurate interpretation of test results.

Other means of diagnosis are the isolation of leptospira from tissues or urine and demonstration of leptospira in urine from suspected cases microscopically. In routine diagnosis these procedures have not generally been used because of the time required to complete, and the lower accuracy.

INCIDENCE IN SOUTH DAKOTA

Over an 18-month period in 1955-57 a survey was made of the incidence of leptospirosis in cattle and swine employing the agglutination test of blood samples submitted for brucellosis testing. Approximately one-third of all samples received during that period was tested. The infection rate in this survey was 4.7% of 6,985 cattle and 3.1% of 1,655 swine samples. Little vaccination of herds was being done at that date to confuse test results.

Although many tests are conducted in the diagnostic laboratory each year, these results probably do not provide accurate figures for the present incidence. Many of the samples are submitted because leptospirosis is suspected so that they are not a true sampling of all the herds. Also, preventive leptospirosis vaccination of herds is more commonly done and some of the positive tests, particularly those of lower titers, may not represent actual present or past infection.

The results of two recent years of diagnostic testing are shown in tables 1 and 2. It is noted that the percent of herds and animals in both cattle and swine showing positive reactions was considerably higher in 1962 than in 1964. A marked difference is also shown in the percent of the positive animals in which titers were in the higher level of 1:1,000 or above, being much greater in 1962. The higher titers obtained on tests are interpreted to indicate relatively recent infections. Differences in rainfall over much of the state in the two years offers the most probable explanation for the apparent increase in infection in 1962, when rainfall was above average. Surface waters and soil moisture are conducive to survival and spread of leptospira. In 1964, dry conditions prevailed over much of the state.

Table 1. Leptospirosis Tests of Cattle — 1962 and 1964

	Herds				Cattle				
Year	Total	Neg.	Pos.	% Pos.	Total	Neg.	Pos.	% Pos.	Titers of 1:1000 or above
1962	1271	896	375	29.5%	3187	2525	662	20.7%	79.3%
1964	1326	1073	253	19.1%	3421	3008	413	12.1%	45.2%

Table 2. Leptospirosis Tests of Swine — 1962 and 1964

	Herds				Swine				
Year	Total	Neg.	Pos.	% Pos.	Total	Neg.	Pos.	% Pos.	Titers of 1:1000 or above
1962	319	261	58	18.2%	2071	1887	184	8.9%	79.9%
1964	304	265	39	12.8%	2429	2287	142	5.9%	58.4%

Leptospira pomona antigen has been used in all of the leptospirosis diagnostic testing. In addition, antigens of *L. canicola*, *L. icterohemorrhagiae* and *L. hebdomadis* were used to test many of the samples. At times, other serotype antigens were included. Almost all of the positive reactions were with *L. pomona*. Occasionally a reaction of relatively low titer was obtained with one of the other antigens. Urine samples were collected from one herd having several reactions with *L. hebdomadis*. Leptospira isolations were attempted with negative results.

The frequency of reactions to serotypes other than *L. pomona* has not increased and their significance is not known. In view of the fact that animals are susceptible to infection by different serotypes, the assumption is that the individuals showing these reactions had been exposed to the types identified in the antigens.

IMMUNIZATION

Commercial bacterins which contain the killed organisms of *L. pomona* became available in the early 1950's. Generally such bacterins stimulate immunity against field exposure for about a year. This period may be variable with different individuals and the size of the infecting dose. In experimental calves inoculated with live *L. pomona* organisms at variable periods after vaccination, occasional body temperature reactions were encountered, and in two, leptospira were reisolated from urine or tissues. The infecting doses were no doubt larger than in an average exposure in the field.

Vaccination results in development of positive titers in a high percent of animals. In a group of 40 cattle tested at intervals after vaccination, 25% were showing positive reactions at one week and 90% at one month. The titers in these vaccinates did not reach the high level encountered in actual infection. Over the next several months the titers decreased and at 8 months only 25% still maintained a detectable titer. The development and retention of positive titers is not essential for, or an indication of, immunity. It was noted that the calves which were challenged with an infective dose of *L. pomona* organisms after vaccination did not develop the high titer which was associated with infection in non-vaccinated calves.

As with immunizing agents for other diseases, leptospira bacterins are for preventive treatment rather than curative. If used in infected herds experiencing abortions or other acute signs, animals exposed before or soon after vaccination would receive little or no protection. Substantial immunity requires a period of two to four weeks after the vaccination is done.

RECOMMENDATIONS FOR CONTROL

Information gained through research and experience with leptospirosis in this country over the

(Concluded, Next Page)

GETTING

green needlegrass

STANDS

By RAYMOND C. KINCH, *professor of agronomy*, and LOREN E. WIESNER, former graduate student, now *instructor, grain inspection laboratory, Montana State College, Bozeman*

Late fall planting with high quality seed—that's a big step toward getting a stand of green needlegrass if you plan to use this vigorous, highly nutritious cool season bunchgrass in range renovation.

Poor stands of green needlegrass (*Stipa viridula* Trin.) are usually blamed on high seed dormancy. However, research at the South Dakota Agricultural Experiment Station suggests how you can increase normal germination in the spring and how to select high quality seed by observing the color.

The normal 5% to 15% spring germination can be greatly increased by late fall planting before the ground freezes. Seed quality can be determined by color and test weight, both directly related to viability and purity in the Experiment Station investigations.

Late fall planting recommendations stem in part from observations on how green needlegrass seed acted in the laboratory. Higher germination percentages were noted after seeds had been prechilled and soaked. By late planting, you can give the seed the same "treatment" to improve germination—moist chilling in winter and early spring.

In the laboratory, green needlegrass seed prechilled at 40°F. for 12 weeks in a 0.2% solution of potassium nitrate resulted in higher germination percentages. These higher percentages matched seed viability or "germination potential" determined by a modified form of the tetrazolium (TZ) test, which is a quick method of finding out if a seed is dead or alive.

Color of green needlegrass seed is related to stage of maturity. All gray color indicates mature seed and this is the kind to plant for best results. Immature seeds are yellow-green to light gray. Commercial seed of uniform maturity is uncommon, mainly because both mature and immature seed are on the plant at harvest time. When severely cleaned, however, most green or light colored seeds because of light weight are removed with light chaffy material.

The Experiment Station tests showed that as color of seed progressed from yellow-green to mostly or all gray, the purity, weight, and TZ viability percent increased. Yellow-green seed had 76.57% purity, 1.248 grams weight for 1,000 seeds, and 22% viability. This compared to all gray seed with 96.39% purity, 3.473 grams weight for 1,000 seeds, and 71% TZ viability. The "mostly gray" lot, containing a few yellow-green seeds, unexplainedly had 84% TZ viability, 13% more than all gray but weighed less. This particular phenomenon needs further study.

Green needlegrass is well adapted to most soil types but makes best growth on sandier soils. It grows to a height of about 3 feet, makes good pasture and excellent hay for all classes of livestock. If plants are permitted to stand they give fairly good winter grazing. It makes excellent recovery after grazing or clipping. Growth starts early in the spring and continues into fall when enough moisture is available. Seed matures early in July. It is usually seeded in mixture with other adapted species.

Green needlegrass seed is expected to be in good supply in South Dakota this year. □

LEPTOSPIROSIS . . .

past 15 years permits some recommendations concerning prevention and control of the disease. These include:

1. Rodents and perhaps other species of wild animals that inhabit farmsteads are frequent carriers of leptospira. In one state a high percent of the skunks were found infected with *L. pomona*. These animals should be exterminated around farm buildings.

2. Animals to be added to herds of cattle and swine from outside sources should be tested prior to bringing to the farm. Isolation and retests in 30 days adds to the safety.

3. Vaccination of herds is becoming a frequent practice. This is a desirable precautionary measure in herds where chances of exposure are increased, either through new additions, mingling with cattle from other herds, or from water drainage from other farms. Local veterinarians familiar with the operations on individual farms are in the best position to advise concerning a vaccination program.

4. Leptospirosis may be confused with some other diseases. With specific tests available, a diagnosis need not depend solely on signs shown by sick animals. An early diagnosis in suspected infection can hasten application of control measures in a herd.

5. It is common for infected animals to eliminate leptospira in urine for extended periods of from a few weeks to several months. Protection of other animals from exposure by isolation is recommended.

6. Humans can also become infected with the leptospira that infect animals. Caution is necessary in the handling of an infected herd. □

soil and water losses

Figure 1. Runoff plots and measuring tanks located at the USDA Madison Research Farm.

By T. C. Olson, *soil scientist (USDA)* and *assistant professor of agronomy;* and C. W. Doty, *agricultural engineer (USDA)* and *instructor of agricultural engineering*

Almost every year South Dakota crops thirst for growing-season moisture.

But when, and if, the moisture falls as rain much of it is lost as runoff which also carries away top soil.

Researchers are measuring just how much of these valuable resources are lost. In one case 100 tons per acre of topsoil was lost in 3 years. This is equal to three-fourths of an inch of topsoil over the entire surface or all of the topsoil within a 30-year period.

Runoff and soil loss are associated with amount and intensity of rainfall: in these measurements two storms per year accounted for only 15% of the rainfall but caused considerably more than half of the runoff and soil loss.

Low moisture supply for growing crops is a major problem in South Dakota.

Usually during some period in the growing season, we need rain. Almost every year, the soil reservoir is only partially filled with water at the beginning of the cropping season.

Even with this history of moisture deficiency throughout the cropping season, we are still losing a considerable portion of the rainfall as runoff. This water loss, plus the resulting erosion, could mean the difference between success or failure of crops in South Dakota.

The magnitude and severity of soil and water losses, and techniques for minimizing these losses, are being studied at the USDA Eastern South Dakota Soil and Water Research Farm near Madison.

Much of the data that is used in planning conservation practices was obtained from measurements made on soils in the more humid areas of the United States. Measurements of runoff and soil losses from soils on the western edge of the Corn Belt will provide information needed for the most effective use of the soil erosion equation as an aid to planning for soil and water conservation in South Dakota.

Research Installations and Operation

Twelve plots are under measurement: three replications of each of four soil-cover conditions. Each plot is 26 feet wide and 80 feet long, with about 6% slope. A 1/45-acre subplot is sampled for runoff, soil loss and crop yield.

Each plot is equipped with a runoff collection apron, conveyor tube and three collection tanks, with a multislot divisor in the outlet between the first and second tanks. The plots and measuring equipment are shown in figure 1. The runoff and the eroded soil are collected in the tanks. After each storm, the runoff is measured and sampled for soil content, then the tanks are cleaned and made ready for the next storm. Inches of runoff and soil loss in tons per acre are computed from the samples.

A weather station maintained in conjunction with these plots records rainfall amounts and intensities, wind direction and velocities, soil and air temperatures, and evaporation rates. These measurements help to interpret the differences in observed runoff and soil losses from the plots and make the plot data more useful in predicting what will occur on particular fields throughout the state.

The four soil-cover conditions

This summary of 3 years of measurements of soil and water losses caused by natural rainfall is a contribution from the Corn Belt Branch, Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the South Dakota Agricultural Experiment Station and the Eastern South Dakota Soil and Water Research Farm, Inc. Appreciation is expressed to C. Russell Umback for his assistance in the planning and operation of this experiment.

on which the runoff and erosion rates are measured include: (1) continuous oats, (2) continuous corn using conventional cultural practices, (3) continuous corn using a mulch-tillage practice, and (4) continuous clean-cultivated fallow. Rows running up and down the slope, although not recommended for conservation of soil and water on your farm, are used on these plots so that the effects of the different cover conditions can be measured without the added effect of the perfect contouring attainable in such short row lengths. The data from these plots will be representative of straight-row cropping in this area.

The conventional corn and fallow plots are plowed and double disked each spring. The continuous mulch-tilled corn and oats plots are not plowed but are prepared for planting by field cultivating and double disking which leave much of the residue from prior crops on the surface. Corn in both treatments is cultivated three times with a regular cultivator. The fallow plots are cultivated on the same days as the corn plots, and also at other times as needed to prevent formation of a crust and to keep them free of weeds. Prior to installation of the runoff plots, the land had been in a corn-oats rotation for several years.

Data and Observations

Runoff and soil loss between April 1 and October 31 were measured in 1962, 1963, and 1964. Rainfall was measured year-round. A comparison of the average April-October monthly rainfall at the Eastern South Dakota Soil and Water Research Farm in the 3-year period with the 30-year (1931-1960) long-term average monthly rainfall reported by the U. S. Weather Bureau is shown in figure 2. The 30-year average is for the Weather Bureau Station at Wentworth, about 10 miles east of the Research Farm.

The monthly and cropping season precipitation for the 3 years of study is shown in table 1. Long-term averages at Wentworth are included for comparison. July rainfall in both 1962 and 1963 was about three times the normal amount, and seasonal totals were above normal in both years.

The rainfall, runoff, and soil loss data summarized in table 2 show that appreciable amounts of our two most valuable resources, water and soil, are being lost as runoff and erosion. The data are averages for three plots under identical cover conditions. During this 3-year period, total runoff ranged from 4.0 inches on continuous oats to 9.65 inches on continuous fallow.

Table 1. Monthly Precipitation at the Madison Farm for the 1962-1964 Cropping Seasons

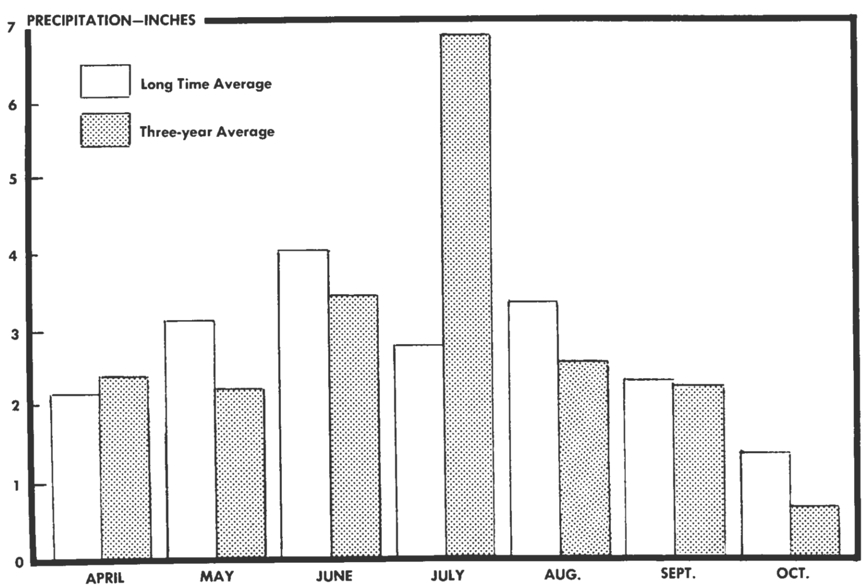
Month	Normal*	Year 1962	1963	1964
April	2.17	2.00	3.09	2.17
May	3.14	3.08	1.95	1.69
June	4.05	3.75	3.06	3.52
July	2.78	8.99	8.22	3.46
August	3.35	3.64	.75	3.31
September	2.33	2.24	2.97	1.56
October	1.37	.35	1.72	0.00
Total	19.19	24.05	21.76	15.71

*Long-term averages at Wentworth, South Dakota.

The soil loss ranged from 3.8 tons per acre on the continuous oats to 100.5 tons per acre on the fallow plots. The 3-year loss from the fallow plots was equivalent to about ¾-inch of soil from the entire plot surface. At this rate, it would take only 25 to 30 years to lose all of the topsoil.

In 1964 the fallow plots lost 1.4 inches of runoff and 7.4 tons of soil per acre, whereas in 1963 the same plots lost 4.2 inches of runoff and 52.2 tons of soil per acre. The fallow plots were treated the same during both years; therefore, the differences in soil and water losses must be ascribed to differences in rainfall distribution and intensity.

Figure 2. Longtime average monthly rainfall compared to 3-year period 1962-64.



Discussion

Soil and water losses by months are shown in figures 3 and 4. The major portion of the losses occurred in July. Figure 2 shows that the 3-year average July rainfall was much greater than normal. This indicates that the soil and water losses would normally be more evenly distributed than is shown for the 3 years of this study.

Most of the runoff and soil losses were associated with a relatively small number of large or high-intensity storms and with prolonged rain periods. Fifteen storms accounted for 33% of the 3-year total rainfall, 93% of the runoff, and 97% of the soil loss from the conventional corn plots. Table 3 shows the cumulative rainfall, runoff, and soil loss for these 15

Table 2. Three-year Summary of Rainfall, Runoff, and Soil Loss from Natural Runoff Plots on 5.8% Slope at Madison

Year	Rainfall	Cropping System	Runoff		Soil Loss
	Inches		% of Rainfall	Inches	Tons/Acre
1962	24.05	Fallow	16.7	4.01	40.81
		Conventional corn	15.2	3.65	18.94
		Mulch-tilled corn	18.6	4.47	19.73
		Continuous oats	14.0	3.37	3.45
1963	21.76	Fallow	19.0	4.23	52.22
		Conventional corn	11.0	2.44	4.91
		Mulch-tilled corn	11.3	2.51	4.11
		Continuous oats	2.7	.61	0.31
1964	15.71	Fallow	9.0	1.41	7.44
		Conventional corn	8.3	1.31	7.10
		Mulch-tilled corn	8.1	1.28	3.62
		Continuous oats	0.1	.02	0.08
Three-year total	61.52	Fallow	15.6	9.65	100.47
		Conventional corn	11.9	7.40	30.95
		Mulch-tilled corn	13.3	8.26	27.46
		Continuous oats	6.5	4.00	3.84
Three-year Average	20.51	Fallow	15.5	3.22	33.49
		Continuous corn	11.9	2.47	10.32
		Mulch-tilled corn	13.3	2.75	9.15
		Continuous oats	6.5	1.33	1.28

Table 3. Cumulative Amounts of Rainfall, Soil Loss, and Runoff from Conventional Corn from 15 Major Storms During the Period 1962-1964

No. of Storms	Rainfall		Runoff		Soil Loss	
	Amount	% of Total	Amount	% of Total	Amount	% of Total
	Inches		Inches		T/Acre	
1	2.68	4	1.82	25	10.03	32
2	3.52	6	2.09	28	15.06	49
3	4.12	7	2.47	33	19.01	61
4	5.99	10	3.47	47	20.89	67
5	8.42	14	4.33	59	22.70	73
10	15.13	24	6.19	84	28.57	92
15	20.40	33	6.85	93	30.16	97

Longer slopes, under similar management, would lose even more. This indicates that 300-foot field slopes in conventionally planted corn after corn in the vicinity of Madison probably averaged about 20 tons of soil loss per acre during the 3-year period of this study. An average of 3 to 5 tons per acre per year is considered the maximum erosion loss that can be safely tolerated on the dominant soils of South Dakota.

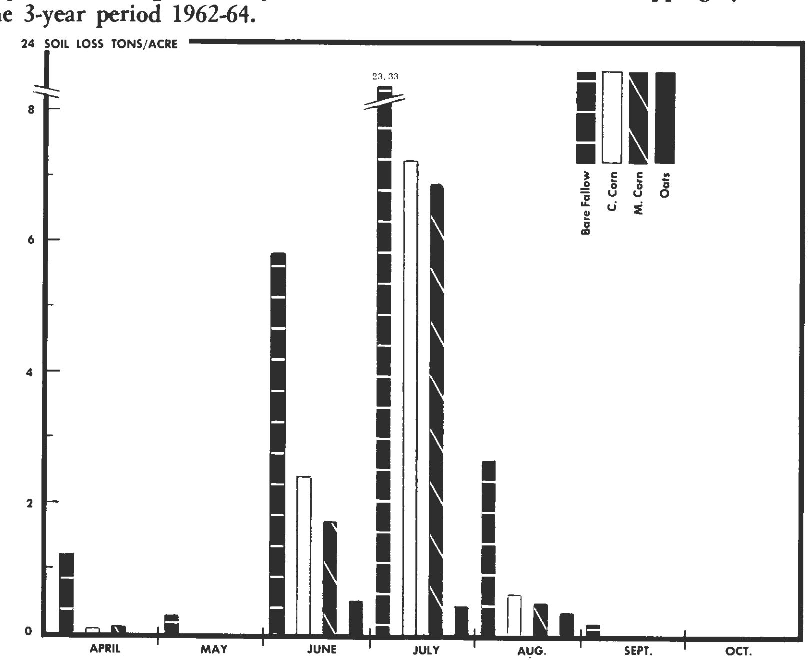
Although rainfall at the plot site was above normal in 1962 and 1963, the 3-year average was only 1.1 inches more than the 30-year average shown in table 1. Even in 1964, when the annual rainfall was 3.5 inches below normal, the 73-foot slope length conventional corn plots lost more than 7 tons of soil per acre. From the slope length relation, we may assume that the soil that eroded from similarly managed 300-foot field slopes in the vicinity was three times the maximum tolerance. This was true even in 1964, when rainfall totaled less than 16 inches.

Beneficial effects of mulching seemed to increase with time. In 1962 the mulched corn plots lost nearly an inch more water than the conventionally tilled plots. However, in 1963 and 1964 water losses were nearly identical for the storms, ranked in order of the amount of soil loss they produced. In the 3-year period, an average of two storms per year produced 15% of the rainfall, 61% of the runoff, and 77% of the soil loss (see figure 5).

Since two storms per year produce three-fourths of the soil loss, and since the time these storms will occur cannot be foreseen, it is as important for the farmers in South Dakota with 20-25 inches of rainfall to use good erosion control practices as it is for farmers in the humid region with 50 inches of rainfall.

Studies at other locations have shown that doubling the slope length usually increases per-acre soil loss by about 40%. A 300-foot slope loses about twice as much soil per acre as a 75-foot slope.

Figure 3. Average monthly soil loss from each of the four cropping systems for the 3-year period 1962-64.



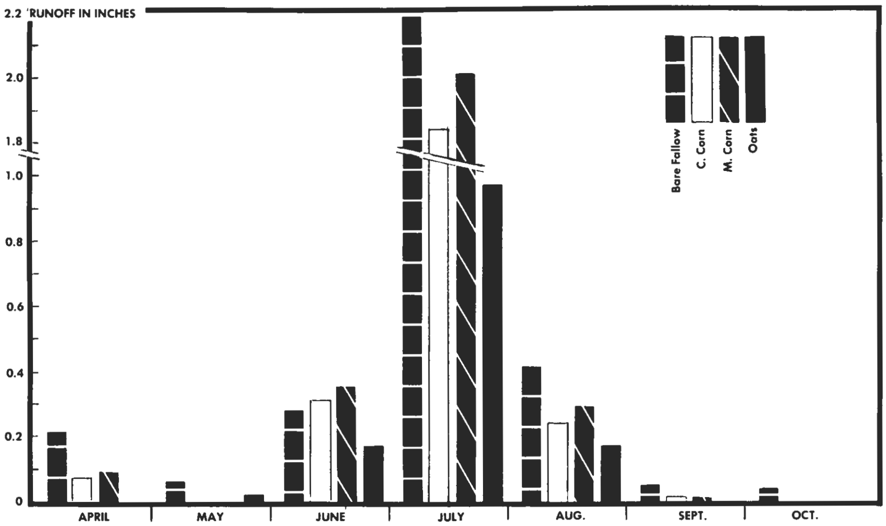


Figure 4. Average monthly runoff from each of the four cropping systems for the 3-year period 1962-64.

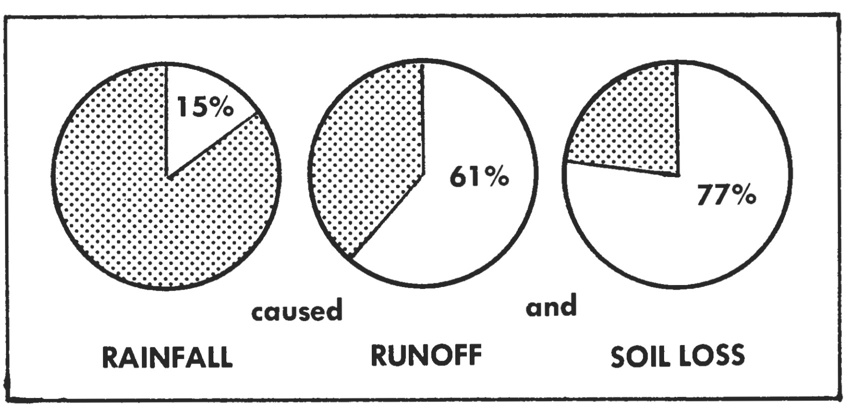
Table 4. Annual Crop Yields from the Natural Runoff Plots at Madison

Year	Conventional corn	Mulch-tilled corn	Oats
	Bu/Acre	Bu/Acre	Bu/Acre
1962	78.5	76.7	19.0
1963	94.4	89.9	38.4
1964	51.9	65.1	26.7
Average	74.9	77.2	28.0

two treatments, and the 1964 soil loss from the mulched plots dropped to about half that from the unmulched corn. Similar trends were observed in corn and oat yields on the runoff plots (table 4). In 1962 and 1963, when rainfall was above average, yields were nearly identical for the mulch-tilled corn and the conventionally tilled corn. However, in 1964, a dry year, the mulch-tilled corn yielded about 15 bu/acre more than the conventionally tilled corn. What caused this advantage is not known, but quite likely it was due to a reduction in moisture evaporation from the soil because of the residue left on the surface or incorporated into the surface layer.

The plots have now been equipped to measure soil moisture, which will provide information on moisture savings by the various practices. Also, it will enable the relating of runoff and soil loss to antacedent soil moisture.

Figure 5. Results of two major storms per year. For the 3-year period 1962-64, two storms per year produced 15% of the rainfall, caused 61% of the average annual runoff and 77% of the average annual soil loss from conventionally tilled corn planted up and down slope on a 5.8% slope.



SUMMARY

The first three years of the plot study have shown these soils to be susceptible to very serious erosion by rainfall when not protected by erosion-control practices. Cover conditions studied were continuous fallow, conventionally tilled continuous corn, mulch-tilled continuous corn, and continuous oats.

Rainfall for the 3-year period was above normal in 1962 and 1963, and below normal in 1964. July rainfall in both 1962 and 1963 was about three times the normal amount, and erosion rates for July were above normal.

Runoff from conventionally tilled corn ranged from 1.3 inches in 1964 to 3.65 inches in 1962. Soil loss from the 73-foot slope length ranged from 4.9 tons per acre in 1963 to 18.9 tons per acre in 1962. On longer field slopes it would have been greater.

Mulch-tilled corn allowed slightly more runoff but less soil loss than conventionally tilled corn. The mulch tilled corn yielded about 15 bu/acre more grain than the conventionally tilled corn in the one year that moisture was in very short supply, probably because evaporation losses were decreased.

During the 3 years of measurement, an average of 2 storms per year accounted for 15% of the total rainfall, and caused 61% of the runoff and 77% of the soil loss. □

are beef price differences real?

By Donald B. Erickson,
assistant professor of economics

New York . . .
Chicago . . .
Sioux City . . .
Sioux Falls . . .

Which of these livestock markets gives the South Dakota beef producer the best return for his choice steer?

They are all about the same—based on a monthly average price.

The actual Chicago and Sioux City prices might be higher, but the difference in transportation costs from a local market makes the average net return to South Dakota producers about the same. An analysis of beef cattle prices for the past six years shows this close price-transportation cost relationship would apply to most other market centers also.

If a producer could sell on one market daily, he would receive about the same average net price regardless to which market the animals were shipped. However, the prices of various markets move up and down and may produce greater price differences than the transportation costs. If this situation exists for a given day when cattle are to be sold, then the alternative market should be used to "maximize" net returns.

PRICE MOVEMENT SIMILAR

The movement of prices up and down from day to day and month to month for the various markets is quite similar. In order to illustrate, an analysis was made using monthly choice steer prices at four locations—New York City, Chicago, Sioux City, and Sioux Falls. The price series included New York wholesale steer price carload lot, Choice carcass grade; Chicago wholesale steer price carload lot, Choice carcass grade; Chicago liveweight slaughter steer price, Choice grade; and Sioux City liveweight slaughter steer price, Choice grade. Each price series was the weighted average price for the month.

The average difference in the monthly wholesale prices between New York and Chicago was $1.71 per hundredweight (table 1). This is about the average transportation cost per hundredweight of carcasses from Chicago to New York. The differences between the average slaughter price in Sioux City and Chicago was $0.91 per hundredweight. The proximity of Sioux Falls and Sioux City was reflected in the price difference of only $0.14 per hundred weight.

Table 1. The Average Choice Steer Price of Each Price Series and the Time Period Included in Each Series

Price Series	Average monthly price for given time period	Average monthly price difference
	Dollars/cwt.	Dollars/cwt.
New York Wholesale Choice carcass grade—January 1957-December 1963	$44.02	
		$1.71
Chicago Wholesale Choice carcass grade—January 1957-December 1963	42.31	
Chicago Choice slaughter grade—January 1957-December 1963	26.01	
		.91
Sioux City Choice slaughter grade—January 1957-December 1963	25.10	
Sioux City Choice slaughter grade—October 1958-October 1964	24.89	
		.14
Sioux Falls Choice slaughter grade*—October 1958-October 1964	24.75	

*This price series was first reported October 1958 on a monthly basis.
Source: "The Livestock and Meat Statistics," USDA, Agricultural Marketing Service, Statistical Reporting Service, Economic Research Service, Statistical Bulletin Numbers 230, 233, and Supplements, Washington, D. C.

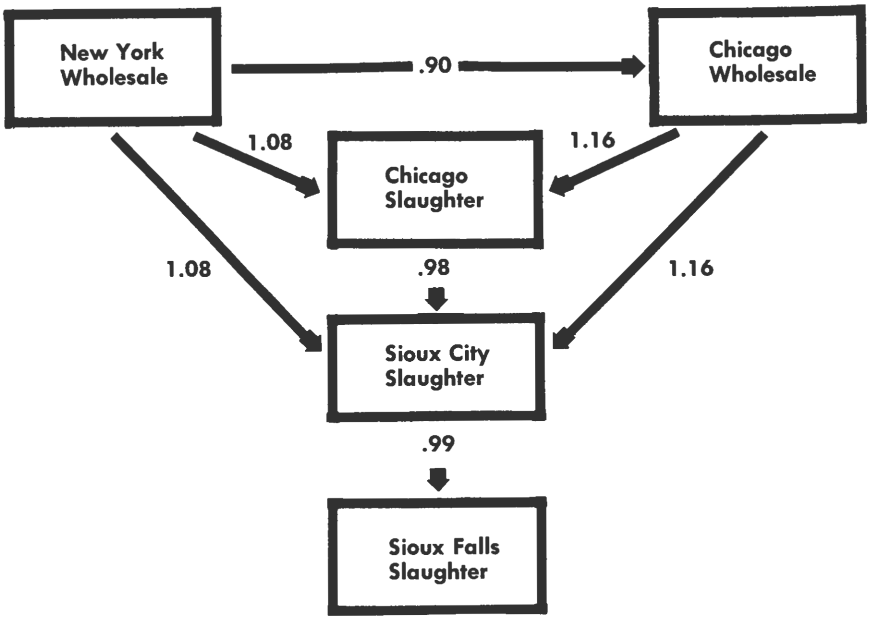
In another study, it was found that the live weight cost of shipping cattle from Sioux Falls to New York City was $2.16 per hundredweight; to Detroit, Michigan $1.72; and to Raleigh, North Carolina $2.09. These costs compare favorably with the average price differences between the various markets.

CARCASS STEER PRICES

The similarity of the price movements can be illustrated in the two accompanying charts. The New York and Chicago wholesale prices moved very closely together throughout the entire time period studied. The differences in the prices during a short time period can be explained by the lack of immediate response to changing the "regular market outlets" to different ones and then returning when the price is again favorable. The simple example of four market locations could be extended to include all of the wholesale outlets. However, the data and analysis would become too voluminous to handle in this article.

Simple regression analysis was used to compare the relationships between the price series. The results indicated that on an average a 1.0% per hundredweight increase of the monthly New York wholesale steer price was associated with a 0.90% increase of the monthly Chicago wholesale steer price. The variation of the New York price explained 90% of the variation of the Chicago price.

The pattern of similarity, is verified in the following chart which shows the coefficients and the arrows indicate the assumed direction of influence, that is New York market affects Chicago market and not the reverse. This figure should be read as follows: For a 1.0% change in the price at the start of the arrow



Price relationships between various markets for Choice grade steer carcasses and slaughter steer prices.

(New York wholesale price), the price of the head of the arrow (Chicago wholesale price) will change by the given coefficient 0.90%. For example, if the New York wholesale price was $40.00 per hundredweight and changed 1% this would be $0.40 per hundredweight. The average change in the Chicago wholesale price would be approximately $0.34 per hundredweight. This is taking the average price difference into account.

LIVEWEIGHT STEER PRICES

A similar comparison between the liveweight slaughter prices of Choice grade steers in Chicago, Sioux City and Sioux Falls showed that the average monthly price movements of Choice slaughter steers were similar (see accompanying chart).

The price in Chicago was, on the average, higher than either the Sioux Falls or the Sioux City price.

The regression analysis suggests a similar association of the New York wholesale price to the Choice slaughter steer price in Chicago and Sioux City. In both a 1.0% increase in the average monthly price of the New York wholesale price was associated with approximately 1.08% increase in the average monthly price of Sioux City Choice slaughter steer prices. The price variation in New York explained about 92% of the price variation in Chicago and Sioux City. The similarity between the percentage changes suggested that the price movements for Choice slaughter steers in Chicago and Sioux City were much the same.

The similarity of price movements between the Chicago and Sioux City slaughter steer Choice grade was further evident in that a 1.0% increase in the Chicago price was associated with .98% increase in the monthly Sioux City price. The variation of the Chicago price explained 98% of the variation of the Sioux City price.

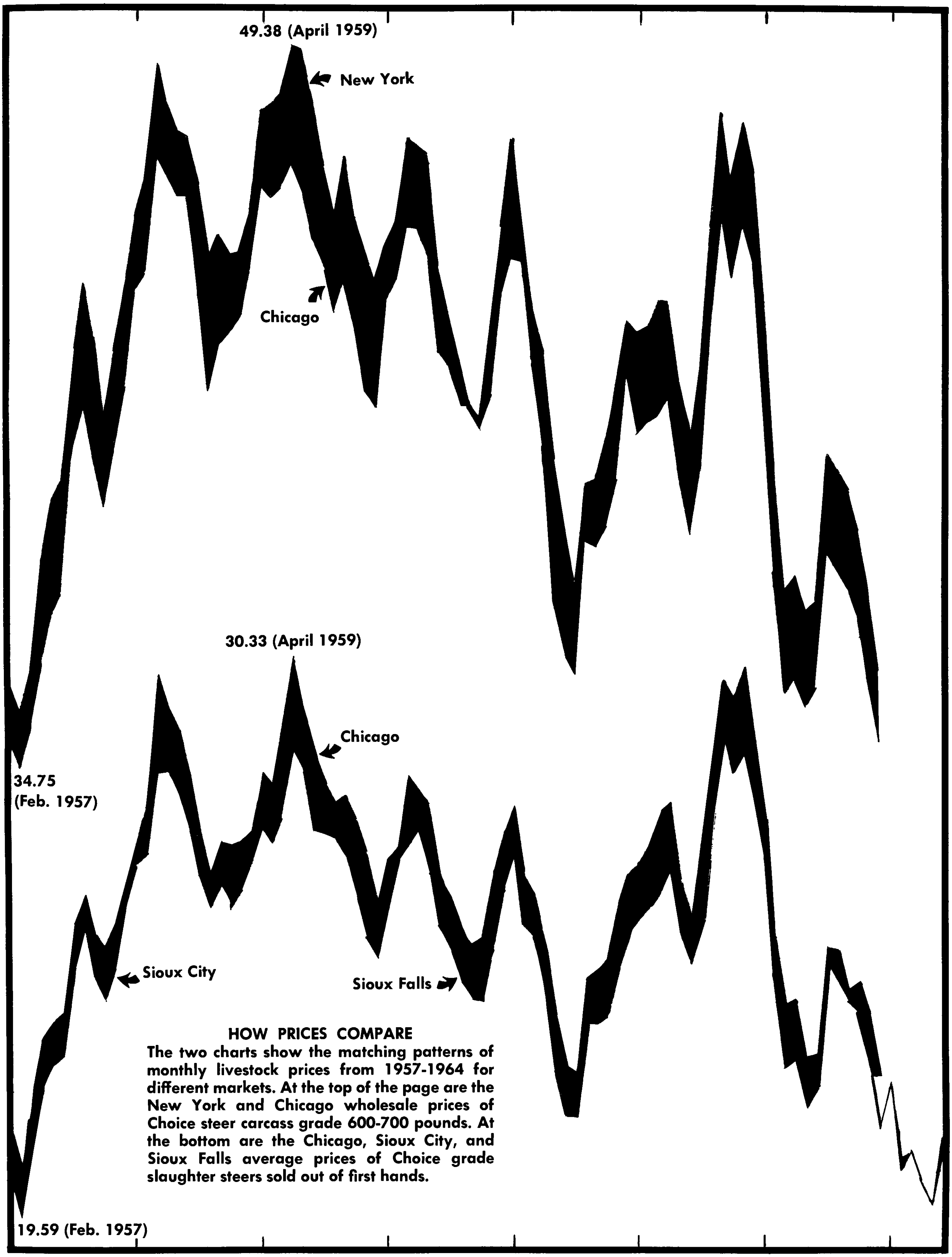
A further similarity between the Chicago slaughter price and Sioux City slaughter price was seen when they were correlated with the Chicago wholesale price. A 1.0% increase in the monthly Chicago wholesale price of Choice steer carcasses was associated with about 1.16% increase in the monthly Sioux City Choice slaughter steer price and similarly about a 1.16% increase in the monthly Chicago Choice slaughter steer price. The variation of the Chicago wholesale price explained 96% and 95% of the variation of the Sioux City and Chicago slaughter prices, respectively. The parallelism of the price series is no accident or one of coincidence. The use of modern means of verbal communication, standard grades and other means of communication facilitates a more competitive pricing system despite the physical distance between the markets.

To further relate this series to South Dakota, Sioux Falls was compared to Sioux City. Lack of similar data was the main reason for not comparing Sioux Falls to the other markets. This indicated that as the price of Choice slaughter steers in Sioux City changed 1.0% the price of similar animals at Sioux Falls changed 0.99%. This is about a one-to-one price change. The Sioux City price explained 99% of the variation of the Sioux Falls price.

SUMMARY

Producers who sell their animals in Sioux Falls will on the average receive about the same price as they would if they sold them in Sioux City or Chicago. However, producers who sell once or twice a year must compare the various markets to determine if the daily price difference between various markets is greater than the transportation costs. If the producer is to maximize his returns, he should ship his cattle to the market center which will maximize his return. This may or may not be the highest market price for the day. The highest market price may be reflected in one location, but the cost of transportation may be greater than the difference between the two locations. If the producer were to sell on one market daily, he would receive about the same average net price as he would if he sold all of his cattle daily in another market.

Finally, various markets reflect, on an average, the changes of prices in the major consumption areas. The modern communications system plus the acceptance of grades as a standard for negotiation means the market place is no longer the local slaughter plant. Instead of local slaughter plants displaying the monopoly power, the ultimate outcome is that they are more competitive than some people would care to believe. The market becomes a nation-wide market. □



HOW PRICES COMPARE

The two charts show the matching patterns of monthly livestock prices from 1957-1964 for different markets. At the top of the page are the New York and Chicago wholesale prices of Choice steer carcass grade 600-700 pounds. At the bottom are the Chicago, Sioux City, and Sioux Falls average prices of Choice grade slaughter steers sold out of first hands.

Nitrogen *CREDITS* from Manure, Legumes

By PAUL L. CARSON, *associate professor of agronomy*

Nitrogen fertility supplied from legumes and manure is best evaluated by the man farming the soil.

These evaluations are not easy at best. But by following certain guidelines along with soil test recommendations you will be money ahead. It usually means fertilizer application to increase yields. But it can also mean a saving when you figure in a previous management practice that has provided some of the plant food elements you otherwise need to buy.

Recommendations by the State Soil Testing laboratory on the South Dakota State University campus are now being made as though no legumes were grown or manure applied. If these practices *are* included in the management program, the farmer himself must now estimate their value and subtract the plant food elements added from those recommended.

On the average, South Dakota soils have lost an estimated 35% of original nitrogen and 40% of original organic matter. However, these losses vary considerably from region to region and even from farm to farm. The new soil testing procedure is an effort to give "tailor-made" recommendations for individual fields. And the vital link is the man who farms the field—he's the one who knows or can figure out what has been put into and taken out of the soil.

LEGUMES FOR MANY PURPOSES

Legumes are grown for many purposes—green manures, hay, pasture, seed, silage, and possibly others. They are able to supply their own nitrogen while they are growing. This is through a relationship with bacteria in which the legume supplies energy and the bacteria supplies nitrogen taken from the atmosphere and converted to a form that the plants can use. This process is called symbiotic nitrogen fixation.

Under certain conditions, the bacteria fix more nitrogen than can be used by the growing plants. Also the nitrogen contained in the legume plants is returned to the soil when the legume is plowed under. This causes an increased supply of available nitrogen in the soil. Nitrogen made available to the coming crop through growth of a legume should be subtracted from that recommended.

When the legume crop is destroyed and the land is again used for grain crops the supply of available nitrogen is usually good. But, how good – how much nitrogen is available? When will I have to add more nitrogen? Those are questions difficult to answer, but the farmer himself can come closer than anyone else. By using table 1 as a guide you can come up with an estimate of nitrogen "credits."

The amount of nitrogen available to crops after plowing a legume decreases as the years go by and depends to some extent on the yield of crops produced. Assume that you grow row crops after plowing the legume. Then the values in table 1 can be divided by 2 the second year and by 4 the third year. Small grains are frequently grown the first year after plowing because of the poor reserve supply of avail-

SOIL TESTING IN FALL

Fall is an excellent time for soil testing:

1. You get a better sample because there's no mud or frost.
2. Differences in yields of various fields are more easily recalled.
3. Fall is the "off season" at the soil testing lab at SDSU so recommendations are processed more rapidly (within 2 weeks)—then you can order fertilizer of desired grades, maybe even apply some of it in the fall.

Your County Extension office has information on testing procedures, cartons for mailing, plus forms needed in submitting the sample.

Recommendations from soil tests when returned to you include a detailed special publication, "Explanation of Soil Test Recommendations."

Table 1. Suggested Average Nitrogen Credits for Legumes

Legume-Grass Sods*		Legume Green Manure Crops†		Miscellaneous	
Percent Legume	Lbs. of Nitrogen Credit	Crop	Lbs. of Nitrogen Credit	Crop	Lbs. of Nitrogen Credit
More than 50%	100	Biennial Sweet Clover	70	Soybeans harvested for seed	20
20-50%	50	Alfalfa and Red Clover	50		
Less than 20%	0				

*Credit for legume-grass sods is based on a total hay crop that would yield 3 tons or more per acre. Decrease credit for lower yields.

†Credit for legume green manure crops is based on excellent to good stands plowed under after October 1st of seeding year, and attaining a height of at least 18 inches. If height attained is less than 10 inches, the growth of the legume should not be credited as suppying additional nitrogen.

(Adapted from Agronomy Pamphlet Series, Iowa State University)

FIGURE 1

Date Sample Received 23 Mar 65

Soil Test Results and Plant Nutrient Recommendations

South Dakota Soil Testing Laboratory

Agronomy Department South Dakota State University

Name John Doe

Sec. 1 ; Twp. 106 ; Rn. 49

County Moody

D

SOIL TEST RESULTS — PLANT NUTRIENT RECOMMENDA NS

A B

Sample Identification	NITROGEN* Supplying Ability of the Soil	PHOSPHORUS* lbs./A. P	PHOSPHORUS* Fertility Rating	POTASSIUM* lbs./A. K	POTASSIUM* Fertility Rating	pH*	SOLUBLE SALT* ECx10^3	SOLUBLE SALT* Relative Concentration	~~Sat. % and~~ Texture	Crop to be grown	Pounds of Plant† Food Recommended N	P_2O_5	K_2O	Suggested M ds of Application
56910	2.0 Poor Fair Good	14	Very low Low Medium High Very high	200	Very low Low Medium High Very high	7.0	.01	Low Medium High Very high	S.L.	Corn	80	45	20	10A,B,C See paragraph number 18 & 17 Please read See comments
	Poor Good		Very low Medium High Very high		Very low Low Medium Very high			Low Medium High Very high						See paragraph number

C

IMPORTANT: *For an explanation of the soil test see the reverse side of this sheet. †Pounds of nutrients may be readily converted to pounds of fertilizer of various grades by consulting paragraphs 3, 4, 5, and 6 of the accompanying pamphlet No. 31, "Explanation of Soil Test Recommendation," which contains suggestions for methods of fertilizer application.

COMMENTS: The paragraphs mentioned are found in Agronomy Pamphlet #31, "Explanation of Soil Test Recommendation," which is enclosed.

able moisture. The land is then planted to a row crop the second year. Under these conditions, the estimates from table 1 are valid for the second year, should be divided by 3 for the third year, and by 5 the fourth year.

NITROGEN FOR SEEDING CROPS

It should be kept in mind that nitrogen not used by a particular crop will be available for succeeding crops. Leaching of nitrogen out of the root zone is unlikely in South Dakota, except on very light-textured sandy soils, under irrigation, or in years when rainfall is well above average.

Nitrogen supplied by green manure crops (those legumes planted with small grain and plowed after October 1) is especially difficult to evaluate. Research data show that the amount of nitrogen supplied is directly proportional to the amount of dry matter produced. Usually about half of the nitrogen turned under in legume plants will become available the first year. Thus a figure of 50-60 pounds of nitrogen per ton of dry hay produced the year of seeding is probably a closer estimate of the amount of nitrogen supplied by the green manure legume turned under than is shown in table 1. This is especially true be-

(Concluded Page 24)

Figure It Out for Yourself

Here's an example to help you evaluate your "credits" for past management—

A farmer in Moody County sent in a sample of soil from a field on which he plans to grow corn. The laboratory sent back results of the tests plus recommendations for fertilizer use (figure 1). In his area, average corn yield should be about 70 bushels per acre.

This field was in alfalfa for 3 years before plowing 2 years ago and planting to corn. This will be the third corn crop after the alfalfa. The farmer plans to apply 3 tons of manure per acre from his cattle feed lot before plowing. The nitrogen credit for growing the alfalfa would be 25 pounds per acre (see table 1, plus explanation). This same information is referred to on the recommendation sheet (paragraph 18) accompanying the test results ("A", figure 1). The nitrogen credit would be 15 pounds for applying the 3 tons of manure (5 times 3 tons, table 2). Again, this same information is referred to on the recommendation sheet ("B", figure 1) by paragraph 17. Thus the alfalfa grown 3 years ago, plus the manure added, would supply 40 of the 80 pounds recommended ("C", figure 1), leaving 40 pounds of nitrogen to be added as commercial fertilizer if he wants to supply the nitrogen needs for the 70-bushel yield he should be able to raise in his area. The difference between the recommended 80 pounds and the 40 pounds actually needed, based on cropping history and management, represent a considerable saving.

The recommended 80 pounds of nitrogen per acre ("C") is based on a 70-bushel yield and the fact that the organic matter content of the farmer's soil tested 2%. The organic matter content determines in part the nitrogen supplying ability of the soil ("D", figure 1). The 2% organic matter in the Moody County farmer's soil will supply an estimated 55 pounds of available nitrogen for the corn crop. The recommendations are determined from special data resulting from extensive research in different corn growing areas of South Dakota.

Essentially the recommendation is determined somewhat as follows: There are about 2,000,000 pounds of soil in the furrow slice of an acre of land. This times 2% gives 40,000 pounds of organic matter to the acre. Since about 6.7% of organic matter is nitrogen, this times 40,000 gives 2,680 pounds as the amount of nitrogen in the soil. Although depending a lot on weather conditions, an estimated 2% of the nitrogen becomes available when the land is cultivated. This 2% times 2,680 gives 53.6 pounds of available nitrogen per acre, or 55 pounds rounded off.

Each bushel of corn requires at least 1.5 pounds of nitrogen for its growth (see table 3). This means the soil, as indicated by the test, is capable of supplying enough nitrogen for a yield of 37 bushels of corn (55 divided by 1.5 = 37). But, as this is an area where 70-bushel yields should be obtained, the crop would need 105 pounds of nitrogen per acre (70 times 1.5 = 105). This means he needs an additional 50 pounds (105 minus 55) of nitrogen. However, it has been established that the roots of the plants are able to take up only 60% of the nitrogen added as fertilizer. Thus it is necessary to add approximately 80 pounds (50 divided by 60%) of nitrogen as fertilizer to supply the 50 pounds of nitrogen needed by the plants, 40 pounds of which is being supplied as credits for past or present management in this example.

Farm Management Decisions

By Kenneth R. Krause
assistant professor, economics

Management—the key to success of a business enterprise—is a far-ranging term which must be broken down into a logical sequence of thought and actions or decisions so that it can be handled effectively.

While management involves the full range of activities of a farm operator, it most of all concerns decision making, implementing decisions and planning for the future. Making the right decision in view of a future filled with some unknowns is difficult. One way to predict future events is to project experiences from the past and condition our projection with new factors that we think will influence our decision.

There's no exact formula for management success, but in continual studies of farm and money management, economists find that certain fundamental or basic procedures are used. These can be combined into a series of logical steps which can be termed a scientific guide for making farm management decisions.

We can divide the activity known as management into two parts. The first includes selection and careful definition of the purposes for which the farm business exists. The second concerns direction, conduct, control and administration of resources at a farmer's command to achieve the desired ends. Attention to all of these factors is necessary for success. Absence of even one can mean only partial success or possibly failure.

A PROBLEM SOLVING GUIDE

Management decision-making involves use of a logical procedure and revolves around problem solving since this is what a farm operator and manager does to achieve the desired ends. Five basic steps have been evolved and following them in proper order is as important as the steps themselves.

NITROGEN . . . (From Page 23)

cause of extreme variability in the amount of growth produced each year due to differences in weather.

Addition of manure is another management practice that has a major influence on soil fertility. Some consider manure to be a farm's most valuable by-product. Others do not consider it so highly. In most cases, one of the best ways to handle manure is to haul it onto fields. When this is done an evaluation of its effect on the soil fertility is also necessary if economical commercial fertilizer use is to be attained.

PLANT FOOD ELEMENTS IN MANURE

The plant food element content of manure varies considerably due to the kind, age, and feed of the animal producing it. The presence of bedding and the way it is handled also greatly influences its value. For purposes of calculation table 2 provides a simple method of estimating the plant food elements applied in each ton of manure.

Table 2. Suggested Average N, P_2O_5 and K_2O Credits for Manure

	Credit, Pounds per Ton		
Kind of Manure	N	P_2O_5	K_2O
Cattle or Hog	5	5	10
Sheep	10	9	19
Poultry and Turkey	20	45	12

Notes:

1. Credits shown apply to manure containing enough straw to have absorbed most of the urine. Excessively "strawy" manure should be credited for K_2O only.
2. Credits shown are equivalent fertilizer values. (Manure nitrogen was considered to be 50% available.)

(Adapted from Agronomy Pamphlet Series, Iowa State University.)

While we are talking mainly about nitrogen here, don't forget that phosphorus, and to a much lesser extent, potassium (or potash), are also important for South Dakota soils (note table 3). In other words, you are after the proper *balance* of fertilizer nutrients in your soil for most profitable production. Much more soil testing is needed throughout the state in order for farmers to get and maintain this proper *balance* of plant food elements in their soils. □

Table 3. Number of Pounds of Plant Foods Removed by Crops (Grain and Straw or Stover)

	N	P_2O_5	K_2O
Corn (per bushel)	1.5	0.5	1.0
Oats (per bushel)	0.8	0.4	0.8
Barley (per bushel)	1.2	0.5	1.0
Soybeans (per bushel)	5.5	1.2	1.8
Flax (per bushel)	4.0	1.1	1.8
Rye (per bushel)	1.6	0.8	1.4
Wheat (per bushel)	1.8	0.75	1.0
Alfalfa hay (per ton)	55.0	12.0	32.0
Bluegrass (per ton)	30.0	11.0	42.0
Red clover (per ton)	43.0	10.0	35.0
Bromegrass (per ton)	32.0	8.4	43.0
Sugar beets (10 tons) tops removed	3.7	1.3	5.6
Potatoes (per bushel)	0.2	0.1	0.3

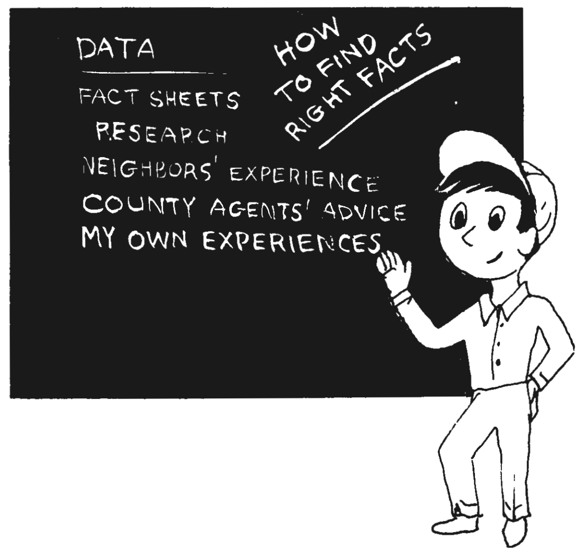
WHAT FACTS AND FIGURES DO I NEED?

STEP 3

To get answers usually calls for facts and figures. In the example from Step 2, a simple budgeting study is needed. Let's say you can get more pounds of digestible nutrients per acre by raising silage corn instead of ear corn. Then you relate or compare this with your current rate of gain and the selling price of the finished livestock. Obtaining these facts may not be easy, especially the first time. You may need a limited fertilizer trial on your farm, advice of a trained consultant, a visit to a farm using the same method you wish to try, a review of research results, or a combination of these.

STEP 4

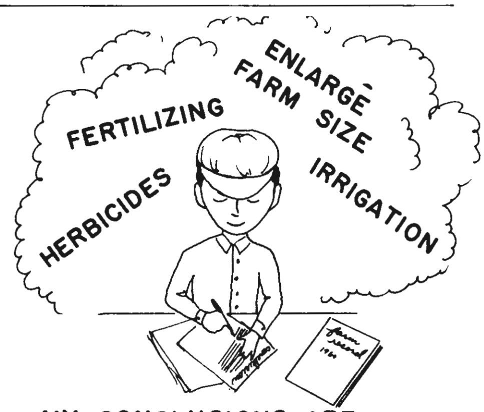
In collecting your facts, obtain closely related or relevant facts and strive for completeness. In other words, you should obtain enough of the right kind of facts to feel comfortable with your answers. Unfortunately for a manager, he seldom knows when his facts are complete. Remember that completeness of evidence is of many types. The main consideration of how far to go is the accuracy needed to plan your operation and how much the collection of evidence or facts will cost in relation to the potential savings.



STEP 5

The final step is interpretation of your findings. Consider carefully what your evidence and facts show. Your own experience and judgment of other people can influence your interpretation. Eliminate any bias or a "leaning" you might have for a given solution. Let the facts themselves determine your action.

Write down what you decide. This serves as a detailed record for your own use so that the necessary action can be taken. It also serves as a guide to other people involved in your farming operation. Perhaps it would be handy for reference in connection with future situations.



MY CONCLUSIONS ARE...

In summary, by following the logical steps in the appropriate order, you should develop an answer that will help you to take action. This is what you were seeking at the beginning.

In the future, successful farm operators-managers will find that they need to set aside more time for solving management problems and making decisions. For solving most problems, a thorough acquaintence with this five-step procedure will help. □

plants without seeds

A project in basic-type research by South Dakota State University botanists may help hurry the day when plant breeders have a "bank" of plant material which is available the year 'round and retains the same characteristics for generation after generation.

By David J. Holden,
associate professor of botany

Nurturing a microscopic-size single body cell of a leaf into a complete new plant, identical to the original, is a new research technique South Dakota Agricultural Experiment Station botanists are using to explore plant growth and development.

This basic type research of "growing plants without seeds"—right now it is done mostly with carrots—holds possibilities of varied practical applications. If the techniques can be successfully used with plants other than the carrot, they will give plant breeders a gold mine of materials and methods which not only would speed up work but might lead to entirely new varieties.

Because the "new" carrots grown from the single cells are identical to the original plant, large numbers of genetically pure plants can be produced for use in research requiring uniformity of individuals. This is arriving at what agronomists and plant breeders need—a "bank" of plant material which retains the same characteristics for generation after generation. Because these new plants would remain always the same, it would mean reducing the variables which often make plant breeding such slow and tedious work. It even goes for individual cells: the scientist can cause mutations or changes by bombarding cells with x-rays or ultraviolet light or radiation. But if something goes wrong the scientist can start all over again with the same identical type of plant or cell to repeat or check his work.

By having a large number of plants available, it is possible to

Figure 1. The small round object is a piece of carrot root, which illustrates the size used at the beginning of the process of tissue culture. The other object is a callus produced in the growth solution (White's media) after about three weeks by a similar piece of carrot.

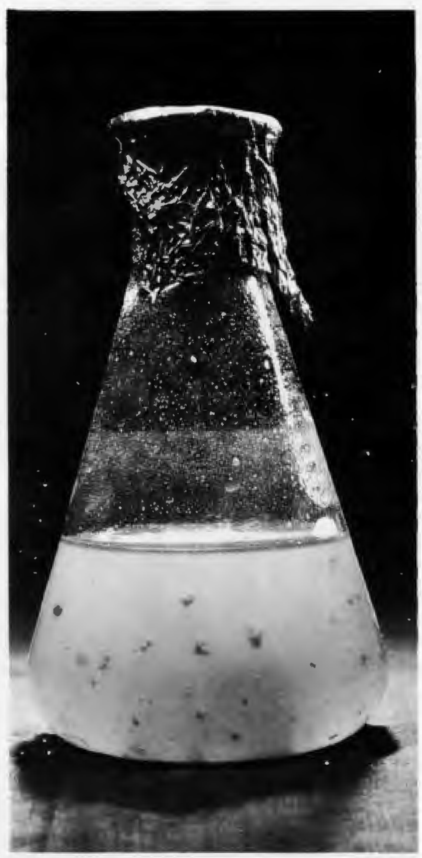


Figure 2. The callus (Figure 1) is placed in a solution of White's media in a culture vessel and agitated on a special machine for another two weeks. Single cells and clumps of cells become suspended in the liquid during the agitation while the callus is growing.

study the nutritional requirements at certain stages. Scientists could use this to more clearly pinpoint the exact stage in which a growing plant would need, for instance, certain minerals.

The abnormal growth of the new plants in certain stages involves cancerous- or tumor-like development of the cells. It may be possible to learn something of the causes of this abnormal growth that is similar or could be applied in the study of cancerous growth in animal tissues. Here, again, a ready source of identical material is an advantage.

Moreover, this material produced in the laboratory would be available the year 'round, not just in the normal growing season. And, as the logical sequence of events leading from a single cell to an embryo is readily repeated, specific stages of plant development would be available at any season.

This study of somatic (body) cells of higher plants by means of tissue culture techniques is fairly new and has been conducted by scientists in various institutions for the past several years. Development of the new plants from a carrot root at South Dakota State University confirms work by other researchers. However, new plants from cells from the carrot leaf repsents original work at the Experiment Station.

Carrots are used mainly to study and become familiar with the techniques involved. Because of detailed knowledge of the carrot plant, botanists use it as a "tool" in many phases of research. The South Dakota work is being expanded into use of tomato leaves and roots, sorghum root tips, radish, and cucumber. Some success in inducing sorghum root tips to grow in a nutrient solution encourages the botanists because sorghum represents a higher order or more complex plant. Of course, an ultimate goal—long dreamed of by the plant breeder—would be production of homozygous plants in one generation.

Essentially what happens in developing the new plants is transformation of the body cells to the embryonic stage. The cells "forget" their specialized function (of photosynthesis, for instance) and revert to unspecialized cells. These unspecialized cells are then asexually triggered to function like fertilized eggs. That, is, they assume this new function without the normal combination of male-female cells. They skip the stage where

Figure 3. A single cell, magnified about 1,200 times, isolated from the suspension step (Figure 2) and which will undergo a series of stages (not shown) of development through callus and embryo formations. This photo is a darkfield illumination taken by a new camera used especially in the Botany Department for microscopic examination of transparent material.

Figure 4. The single cell grows into a callus as in Figure 1. Microscopic examination would show embryos in various stages of development.

Figure 6. Plantlets continue to grow in actual culture vessel.

ale and female cells combine to form a fertilized egg cell.

To the plant breeder this means that unwanted characteristics which might be contributed by either or both parents are not present. The plant is genetically identical to one parent. This may eventually eliminate much time for the plant breeder.

The way the botanists grow the new plants is something like this: A small piece cut from the carrot root or leaf is placed in a liquid or agar (solid) solution or medium. As these cells from the body of the root or leaf start to grow, more hormone is added to the solution. This induces growth of a callus, a soft protective tissue formed by plants over wounded or cut surfaces. (An example is the growth that covers a section of bark cut from a tree). Certain cells forming this wound or protective tissue divide rapidly. This abnormal type of callus growth is something like a cancer of the plant and the unspecialized cells are similar to cancerous cells.

Next the callus cells are placed in a liquid containing a high level of hormone. This is then agitated or subjected to movement in special vibrators. Single cells or clusters of cells slough off into the solution during the agitation step.

The single cells or small clusters are then placed in a fresh solution which simulates the embryonic condition and agitation is continued for two weeks to a month. At this point different stages of plant development can be readily identified. Callus tissue on which roots have formed and embryo-like structures are removed and placed in a solution of low or no hormone. Shoot development usually follows and development of an entire plant takes place.

One of the hormones used as a substitute for the normal plant hor-

Figure 5. After about two weeks, the first plantlets appear. Many of these are derived from the continued growth of a single cell into the multicellular plantlets.

Figure 7. Transferred to polypots, the growing plantlets are fed standardized fertilizer solution. These represent duplicates of the parent plant and are the same genetically, unless mutation — a most improbable event — takes place. However, the scientist can at some times during the sequence of growth, cause mutation.

mone in "feeding" the cells is 2,4-D. Coconut milk is also used as a stimulent. In the studies with tomatoes the botanists use 2,4-D as well as kinetin, a growth regulator-hormone.

As this research progresses it poses numerous questions, a major one being: Can somatic (body) cells from other organisms be induced to behave in a fashion similar to those of carrots? If so, is this a general biological phenomena or is it just unique to a few types of plant tissue such as that of the carrot? □

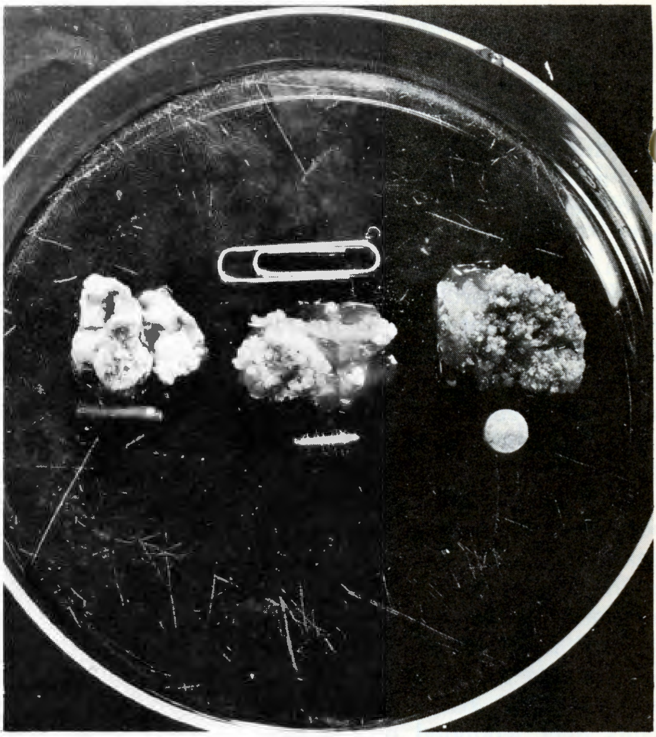


Figure 8. Pieces of radish, tomato and carrot (left to right) and the plant parts from which callus is derived to start the process of tissue culture. Experiments have also been conducted with cucumber. Greatest success has been obtained with the experiments on carrots.

WATER USE STUDIES

Water use studies in eastern South Dakota will be conducted the next two years by the Economics Department of the South Dakota Agricultural Experiment Station under sponsorship of the U. S. Department of the Interior and the East Dakota Conservancy Sub-District.

Investigations concerning development of water resources in the Big Sioux River Basin and in an area north of the Missouri River between Yankton and Jefferson are to be made under a grant of $20,000 from the Bureau of Reclamation of the Interior Department. Much of this area is within the East Dakota Conservancy Sub-District, which comprises 11½ counties in eastern South Dakota. The Sub-District will provide $15,000 over a two-year period for research in certain aspects of water use within its boundaries. Present water resources and existing development will be inventoried.

Included in the studies will be both surface and ground water supplies for irrigation, municipal and industrial uses. Comparison of future demands for water with known supplies may identify areas which will face water shortages. Costs and benefits associated with different purposes served by alternative water uses, whether to the water-user or to the area, will be estimated in a later phase of the study. Scope of the investigation encompasses recreation development and pollution control.

Water quality at Webster, S. D., is the problem for research supported by a $9,000 grant from the Office of Saline Water of the Department of the Interior. Webster is the site of the brackish water conversion plant that has been in operation since 1962. It is one of five desalinization demonstration plants authorized by 1958 legislation. The plant at Webster uses the membrane process, called electrodialysis, for conversion of saline water. The four demonstration plants at other locations use different processes.

The Webster demonstration installation is useful for research into the removal of dissolved salts from saline water. It also supplies Webster with a municipal supply of water having reduced mineral content.

"Saline" water contains more than 1,000 ppm (parts per million) of dissolved solids. Typical ocean water contains 35,000 ppm of dissolved salts. Water is "brackish" between 1,000 and 35,000, and is defined as "fresh" if under 1,000 ppm. Untreated water at Webster has about 1,800 ppm of dissolved salts; and the treated water, less than 275 ppm.

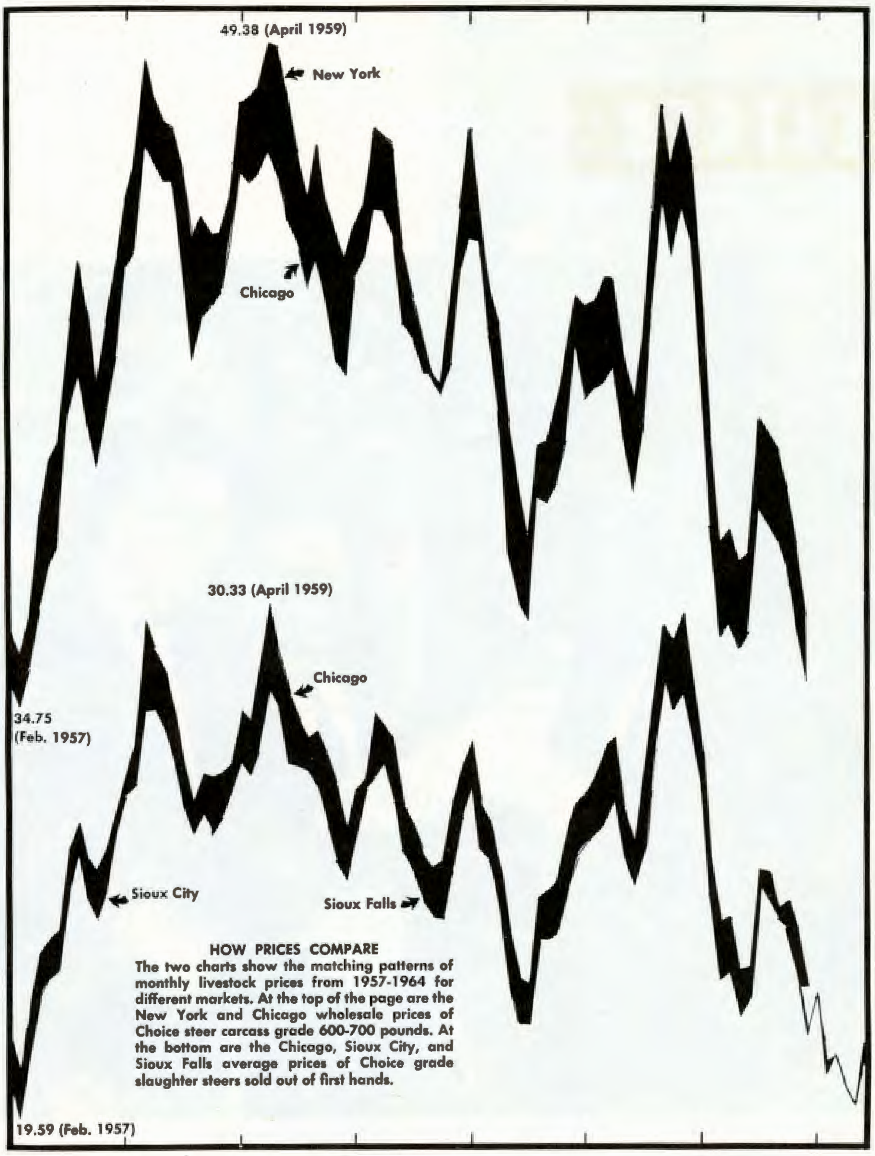
Webster is representative of an area where water is brackish. The study will seek to identify and measure the effects of a changeover from a municipal supply of brackish water to one of improved quality as experienced by residential, institutional, commercial, and industrial water users. The knowledge gained should serve as a guide for communities planning to improve water quality. □

WEATHER

South Dakota weather data is being summarized through a cooperative effort of the U. S. Weather Bureau and the South Dakota Agricultural Experiment Station (See "Weather Data from a Computer," South Dakota FARM & HOME RESEARCH, Vol. XVI, No. 2, Spring 1965).

Orville G. Bentley (left, above), Dean of Agriculture and Biological Sciences, and Director of the Experiment Station, receives from State Climatologist Walter S. Spuhler a copy of the first in the series of 70 summaries. Dennis L. Moe, head of the Agricultural Engineering Department (second from right) and William F. Lytle, associate professor of agricultural engineering, are assisting in the work by SDSU's Weather Science Section.

Data is being taken from more than 2 million punchcards some of which are stored in the floor-to-ceiling files in the background of this photograph. Summaries will help farmers determine planting dates and moisture potential. They also are used for water resources development and microclimate research at SDSU. Other weather stations included in the first group of summaries to be published are Aberdeen, Brookings, Newell, Pierre and Pine Ridge.



HOW PRICES COMPARE
The two charts show the matching patterns of monthly livestock prices from 1957-1964 for different markets. At the top of the page are the New York and Chicago wholesale prices of Choice steer carcass grade 600-700 pounds. At the bottom are the Chicago, Sioux City, and Sioux Falls average prices of Choice grade slaughter steers sold out of first hands.

Lightning? No. This is a graph that shows patterns of similarity of livestock price fluxuations from several markets. See article "Are Beef Price Differences Real?", Page 19.

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